

JPRS 69083

11 May 1977

U S S R

EAST
EUROPE

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

MATERIALS SCIENCE AND METALLURGY

No. 45

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

Reproduced From
Best Available Copy

U. S. JOINT PUBLICATIONS RESEARCH SERVICE

20000215 078

68

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22151. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

BIBLIOGRAPHIC DATA SHEET		1. Report No. JPRS 69083	2.	3. Recipient's Accession No.
4. Title and Subtitle USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS - MATERIALS SCIENCE AND METALLURGY, No. 45 ,				5. Report Date 11 May 1977
7. Author(s)				6.
9. Performing Organization Name and Address Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201				8. Performing Organization Rept. No. 10. Project/Task/Work Unit No.
12. Sponsoring Organization Name and Address				11. Contract/Grant No. 13. Type of Report & Period Covered
				14.
15. Supplementary Notes				
16. Abstracts The report contains abstracts and news items on metals, alloys and superalloys, analysis and testing of metals and materials, coatings, composites, metal corrosion, extraction and refining, forming, instrumentation, lubricants, mechanical and physical properties of metals, powder metallurgy, textiles, welding practice, glass and ceramics, heat treatment, nuclear science and technology, semiconductor technology, thermomechanical treatment, and related fields.				
17. Key Words and Document Analysis. 17a. Descriptors USSR Eastern Europe Metallurgy Welding Corrosion Crystallography Solid State Physics Lubricants				
17b. Identifiers/Open-Ended Terms				
17c. COSATI Field/Group 11B, 11F, 11H, 13H, 20B, 20L				
18. Availability Statement		19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 65	
		20. Security Class (This Page) UNCLASSIFIED	22. Price	

JPRS 69083

11 May 1977

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS
MATERIALS SCIENCE AND METALLURGY

No. 45

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

Photoreproductions of foreign-language sources may be obtained from the Photoduplication Service, Library of Congress, Washington, D. C. 20540. Requests should provide adequate identification both as to the source and the individual article(s) desired.

CONTENTS	PAGE
Aluminum and Its Alloys.....	1
Analysis and Testing.....	4
Coatings.....	6
Composite Materials.....	8
Conferences.....	15
Corrosion.....	18
Extraction and Refining.....	21
Graphite.....	22
Heat Treatment.....	24
Instrumentation and Equipment.....	25
Magnesium.....	27
Mechanical Properties.....	28
Powder Metallurgy.....	29
Single Crystals.....	34
Steels.....	35
Superhard Materials.....	38
Thermomechanical Treatment.....	39
Thin Films.....	40
Titanium.....	41
Transformation and Structure.....	46
Welding.....	47
Miscellaneous.....	52

Aluminum and Its Alloys

USSR

UDC 669.71'35'

ANISOTROPY OF THE SUBSTRUCTURE AND DISSOCIATION ALONG SUB-BOUNDARIES IN
PRESSED D-16 ALLOY BARS

Sverlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 6, Dec 76
pp 1191-1195 manuscript received 14 Jan 76

VAYNBLAT, YU. M., LEPESHENKOV, YE. K., BER, L. B., and BUKHARINA, N. V.,
All-Union Institute of Light Alloys

[Abstract] An investigation is made of the anisotropy of the substructure and the concomitant anisotropy of dissociation along sub-boundaries in pressed bars of D16 alloy (composition 4.1 wt.% Cu, 1.5% Mg, 0.7% Mn, 0.4% Fe, 0.25% Si and the remainder Al) after pressing at temperatures of 320-460°C, and also after quenching from 500°C in water and natural or artificial aging at 200°C. The substructure was analyzed by measuring the mosaic angles in separate grains, determining the dimensions of subgrains, determining the azimuthal angles of disorientation between adjacent subgrains, and measuring disorientation from etching patterns in individual grains. The results show that the grains in pressed bars having a polygonized structure are bent around the pressing axis at angles of 15-25°; bending in the perpendicular direction is less than 5°. Disorientations on longitudinal sub-boundaries parallel to the pressing axis are greater than on transverse grain boundaries. Longitudinal sub-boundaries are decorated by segregations even on the stage of natural aging. Dissociation on longitudinal sub-boundaries during artificial aging takes place with greater intensity than in the body and on transverse sub-boundaries. The anisotropy of strength properties of pressed bars and the variations in this anisotropy during artificial aging are attributed to the anisotropy of the substructure and of dissociation processes. Figures 4; references 7: 5 Russian, 2 Western.

USSR

UDC 539.43:669.715:620.19

DEVELOPMENT OF FATIGUE CRACKS IN SHEETS OF D16A AND V95A ALUMINUM ALLOYS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 46-51 manuscript received 8 Apr 76

YAREMA, S. YA., OSTASH, O. P., RYCHIK, V. P., BELETSKIY, V. M., ZBOROMIRSKIY,
A. I., POLUTRANKO, I. B., BELYAYEV, V. N., and MARGOLIN, G. S., Institute of
Physico-Mechanics, Academy of Sciences UkrSSR, L'vov; Kiev Mechanics Plant

[Abstract] Studies were made of the development of fatigue cracks in the materials mentioned in the title in several structural states through the

full range of change of load amplitudes. The results of the experiments are compared with data from the literature on alloys of this type and serve as a basis for comparative analysis of their efficiency. The process of development of a fatigue crack is characterized by four parameters: the threshold and critical values of stress intensity factor, as well as the constants v_0 and q . The values of the critical stress intensity factor produced by the authors by their indirect method are compared with coefficients produced for similar materials by other researchers, and a "colossal" variation in these data is found, probably resulting from the extensive plastic zones in advance of fatigue cracks propagating upon fracture. Considering all available information, the authors find they do not have sufficient basis for precise comparisons. However, since their values for critical stress intensity factor fall within the range of data in the literature for similar alloys, they conclude in any case that they are not contradictory. Figures 3; references 29: 15 Russian, 14 Western.

USSR

UDC 539.26:620.18

ON THE FEASIBILITY OF MAKING HARDENED ALUMINUM BY USING LASER BEAMS AND SHOCK WAVES

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 6, 1976 pp 90-93
manuscript received 19 Sep 75

MIRKIN, L. I., and SMYSLOV, YE. F., Moscow State Pedagogical Institute,
Department of Solid State Physics

[Abstract] The article gives the results of a study on the simultaneous action of high temperatures and pressures caused by shock wave loading and pulse heating by laser emission on the hardening of aluminum. The initial material was aluminum filings. The laser pulses were on a wavelength of $1.06 \mu\text{m}$ with duration of 10^{-3} s and energy of about 30 J. Shock wave loading was contained by steel cylinders 50 mm long with inside diameter of 4-5 mm and wall thickness of 1-2 mm. The explosive was ammonite with a detonation rate of 4.2 km/s. It was found that both effects produce monolithic specimens from filings. The microstructure of specimens produced by laser action showed fine grains that were rounded in contrast to the long grains of the filings that are typical of plastic deformation. The microstructure of the specimens made by shock wave action shows non-homogeneity of the central and peripheral regions due to the specific nature of shock wave propagation in the cylinders. The microstructure of the peripheral region has large nonequilibrium grains with traces of plastic flow. The central region seems to be a molten zone formed by the Mach interaction of shock waves with maximum thermodynamic parameters in this part of the cylinder. Measurements of microhardness showed that neither type of action improves on the increased hardness due to the mechanical

action of filing. All results show extreme nonuniformity of the structure and properties of specimens made by shock wave loading, which is an indication of the steep gradients of pressures, temperatures and mass velocities of particles inside the specimens with this kind of loading. Figures 2; references 9: 8 Russian, 1 Western.

USSR

UDC 669.28:539.374

THERMOACTIVATION ANALYSIS OF THE PROCESS OF LOW-TEMPERATURE CREEP OF ALUMINUM

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 6, Dec 76
pp 1266-1272 manuscript received 23 Sep 75

YAROSHEVICH, V. D., VLADIMIROVA, G. V., RYVKINA, D. G. and CHUCHMAN, T. N.,
Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] On the basis of a technique developed, the authors define the functional relationship between activation energy and applied stresses. It is shown that this technique can be used to find the values of effective stresses along the creep curve. In this connection, the effective stresses that control creep rate amount to hundredths of the external applied stress. Causes are found for the spread of data on creep rate ordinarily observed in experiments. Figures 4; references 5: 2 Russian, 3 Western.

Analysis and Testing

USSR

UDC 669.183:620.186.2

USING HIGH-TEMPERATURE METALLOGRAPHY TO STUDY NONMETALLIC INCLUSIONS

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 1, 1977 pp 38-41 manuscript received 20 Aug 76

YAVOYSKIY, V. I., KRYAKOVSKIY, YU. V., CHUKHLOV, V. I., ROMANENKO, D. G., LEBEDEV, V. N., FETISOV, G. I., and TEREKHOV, A. N., Moscow Institute of Steel and Alloys

[Russian abstract provided by the source]

[Text] The method of high-temperature metallographic analysis is used to study sulfide inclusions in grade 35 acid and basic steel with different versions of reduction, and also in metal produced by mixing acid steel with basic steel in the ladle. The sulfide inclusions are heterogeneous in structure: their composition includes high-melting components--oxide inclusions. Corresponding to the higher-melting oxide inclusions is a sulfide shell with a relatively low melting point. The location of the sulfides in the metal, in particular with respect to the boundaries of the natural (cast) grain, is determined to a considerable extent by the peculiarities of the way that the oxide inclusions on which these sulfides have precipitated are distributed in the metal, rather than by their melting point. References 9; all Russian.

USSR

UDC 539.3

IMPROVING THE PRECISION OF THE ACOUSTIC METHOD OF STRESS DETERMINATION

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 114-116 manuscript received 5 Nov 74

GUSHCHA, O. I., GUZ', A. N., MAKHORT, F. G. and LEBEDEV, V. K., Institute of Electric Welding imeni Paton, Academy of Sciences UkrSSR, Institute of Mechanics, Academy of Sciences UkrSSR

[Russian abstract provided by the source]

[Text] The principles that govern propagation of small perturbations in media with initial deformations yield fundamental relations for determining the magnitudes and signs of stresses in the uniaxial and biaxial stressed states. The proportionality factors in these relations depend on the elastic constants of second and third orders as determined beforehand. Errors in determination of the constants of elasticity are reflected in the precision of the method. To improve accuracy, it is suggested that coefficients combining experimentally determined constants be used rather than the individually determined constants. Figures 2; references 8: all Russian.

USSR

UDC 621.791.052.08

QUALITY CONTROL OF WELDED JOINTS BY GAMMA SPECTROMETRY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11(284), Nov 76 pp 68-69 manuscript received 31 May 76

ADAMENKO, A. A., KUKLIN, V. M. and BELOKUR, I. P., Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences UkrSSR

[Abstract] The use of the gamma-spectrometric method for quality testing of welded joints is hindered due to the influence of seam height on sensitivity and the need to increase the specific activity of sources significantly in order to decrease errors related to the fluctuations in the flux of ionizing radiation. These shortcomings can be eliminated and defect detection rates increased by the gamma spectrometric method in which the detector is an NaI scintillator with an FEU-35 photomultiplier. The signal from the detector is fed to a pulse analyzer, the signal from which is recorded. Formulas are presented for calculation of the gamma radiation energy necessary to assure optimal testing of steel products of any given thickness and for the signal/noise ratio as a function of collimator thickness with various geometric arrangements of the apparatus. Figures 3; references 3: all Russian.

Coatings

USSR

AN ANTICORROSION TITANIUM COATING

Moscow TSVETNYYE METALLY in Russian No 12, Dec 76 p 97

CHERNOVA, V. I., OLESOV, YU. G. and OGNEV, R. K.

[Text] The Institute of Titanium has developed and introduced an anti-corrosion coating based on epoxy resins in which the reinforcing material (filler) is titanium powder consisting of crystals with a highly developed surface. The coating is prepared by using the following components, taking the mass of the epoxy resin (ED-20, ED-16, GOST 10587-72) as 100%; plasticizer (dimethyl phthalate, GOST 9657-71) 7-12%, hardener (polyethylene polyamine, TU specifications 6-02-594 - 70) 8-12%, filler (titanium powder with granularity of 0.25 mm, TU specifications 48-10-9 - 75) 75-125%. The coating is brushed on or sprayed. In corrosion resistance the titanium powder has the characteristics of the compact metal, and use of the powder improves the physical and mechanical properties of the coating by a factor of 1.5-2 as compared with coatings of ED-16 epoxy resin.

<u>Mechanical characteristics</u>	<u>ED-16 + titanium powder (1:1)</u>	<u>ED-16</u>
Strength, kgf/cm ² :		
tensile	up to 1000	100-300
bending	750-800	200-400
compression	2000-2100	1200-1300
Shearing adhesion to steel, kgf/cm ²	140-150	120

The corrosion resistance of the coating has been checked under industrial conditions in more than 30 different aggressive media. Tests results have shown the resistance of titanium-containing coatings in several widely used media.

<u>Medium</u>	<u>τ, hrs</u>	<u>t, °C</u>	<u>Medium</u>	<u>τ, hrs</u>	<u>t, °C</u>
H ₂ SO ₄ (25-95%)	1000	20-22	KOH (5-10%)	1000	20-70
HNO ₃ (50%)	1000	20	FeCl ₃ (10%)	220	70
HCl (5%)	1000	20	CuSO ₄ (10%)	220	70
CH ₃ COOH (1-5%)	1000	70	ZnS (10%)	220	70
NaOH (5-10%)	1000	20-70	Gasoline	1000	20
S0 ₂ (gas+water)	2000	20	Sea water	20,000	15-24
Electrolyte (15% H ₂ SO ₄ , 0.25% Zn)	2000	18-24			

The titanium anticorrosion coating has been widely used in many sectors of the Soviet national economy. It is used for coating reinforced concrete and metal tanks subjected to the action of acid, alkali and other aggressive media; structural elements and structures; galvanic tanks for settling,

cadmium plating, anodic etching, zinc cyanide metal plating and also for other galvanizing processes. At the present time this coating is protecting more than 1 million square meters of surface on a variety of equipment and structures. The coating has also been introduced in enterprises of the Ministry of Non-ferrous Metallurgy (the "Yuzhuralnikel'" Combine, enterprises of the "Sredaztsvetmetremont" Trust, etc.). The total savings from using titanium coatings has exceeded 3 million rubles. Expansion of the extent of introduction of the coatings will solve the problem of effective utilization of dispersed fractions of grade TG-Tv sponge titanium produced both in the Kroll process and in development of techniques for continuous production of titanium.

USSR

UDC 539.4.-69.24.26.28

INFLUENCE OF COATINGS ON THE STRENGTH OF REFRACTORY FIBERS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1, Jan-Feb 77 pp 73-76 manuscript received 26 Dec 74

FEDORENKO, V. K. and LYUTYY, YE. M., Institute of Physico-Mechanics, Academy of Sciences UkrSSR, L'vov; Institute of Problems of Material Science, Academy of Sciences UkrSSR, Kiev

[Abstract] A common shortcoming of tungsten and molybdenum reinforcing fibers is the fact that in the process of manufacture and subsequent use of composite materials, the reinforcing components interact, which has a negative influence on their strength. In order to prevent this interaction, it is desirable to use diffusion barriers in the form of metallic and ceramic coatings. Naturally, these coatings, which are highly corrosive and have low strength and ductility, actively influence the mechanical properties of the refractory fibers. This study was undertaken to establish the influence of the coatings on the strength of refractory fibers at high temperatures. Tungsten and molybdenum fibers type VA, MCh, and MV-50 were studied, coated with titanium nitride, zirconium carbide, aluminum oxide and chromium oxide. The coatings were produced by precipitation from the gas phase for zirconium carbide and titanium nitride, by solution ceramics methods for aluminum oxide and chromium oxide. Fibers with and without the coatings were tested for short- and long-term strength. The rupture of most of the specimens followed the classical pattern of creep of materials, although at high stresses the stages of unstable and accelerated creep were not recorded. At 900°C, fibers coated with aluminum oxide had the lowest stable creep speeds. As the test temperature rose, the influence of the coatings decreased and at 1100°C almost disappeared. Zirconium carbide and titanium nitride coatings slightly increased the creep rate. Thus, coatings of TiN, ZrC, Al₂O₃ and Cr₂O₃ not only do not cause deterioration in the heat resistance of fibers, but in some cases even improve them and may serve as barriers preventing the growth of diffusion zones. Figures 3; references 6: all Russian.

Composite Materials

USSR

UDC 669.35:539.538

INFLUENCE OF THE STRUCTURE OF A COPPER-TITANIUM CARBIDE COMPOSITE ON
FRICTION PROCESSES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 37-40
manuscript received 15 Jul 76

BARANOV, N. G., SEMENOV, YU. N. and BRODNIKOVSKIY, N. P., Kiev Institute
of Civil Aviation Engineers

[Russian abstract provided by the source]

[Text] An investigation is made of the wear resistance of a copper-titanium carbide composite material as a function of the grain size and amount of titanium carbide. It is established that it is more proper to relate wear resistance to the structure of the material than to its hardness. Reinforcing ductile materials with refractory particles is an effective measure for counteracting wear. Under given test conditions, materials with a coarsely heterogeneous structure had the best capacity for work. Figures 1; references 11: all Russian.

USSR

UDC 621.74.032:669.715:677-15.539.4

FACTORS INFLUENCING THE FORMATION OF STRUCTURE AND PROPERTIES OF COMPOSITE MATERIALS IN AN ALUMINUM-CARBON FIBER SYSTEM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2 (170), Feb 77 pp 58-64
manuscript received 25 Sep 75

SALIBEKOV, S. YE., ZABOLOTSKIY, A. A., TURCHENKOV, V. A., KANTSEVICH, I. A.,
and FADYUKOV, YE. M., All-Union Scientific Research Institute for Aviation
Materials

[Abstract] A study was made of the influence of technological modes of forced saturation on the mechanical properties of a composite aluminum-carbon fiber material; the nature of rupture of specimens produced in various technological modes was determined and an attempt was made to explain the incomplete achievement of the theoretical strength of the fibers in the material. Three types of materials can be formed: a) with drawing of the fibers; b) with development of sliver fracture; and c) with brittle fracture. The transition of the first type of fracture to the second occurs with an increase in the pressure, temperature or time of saturation. The best mechanical properties are observed in specimens with sliver fracture, similar to the fracture of natural composites such as wood. The insufficient

strength of specimens with the first type of fracture is explained by the low strength of the bond at the interphase boundary, of specimens with the third type of fracture -- by softening of the carbon monofilaments as a result of their interaction with the melt matrix. The area of optimal technological modes providing for the production of a composite with good mechanical properties is quite narrow. A further increase in the properties of the material requires the creation of methods of preprocessing of carbon fiber allowing improvement of interlayer shear in the material, as well as optimization of the technological process. Figures 7; references 7: all Western.

USSR

UDC 621.385.002.2:621.793

USE OF COPPER-TITANIUM CARBIDE COMPOSITE MATERIAL IN ELECTRIC VACUUM DEVICES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2 (170), Feb 77 pp 72-75
manuscript received 2 Nov 76

KUZ'MENKO, A. S., LOBOV, G. P., MAGNITSKIY, O. N., RADCHENKO, L. A. and
STRUK, L. I., "Svetlana" Union, Leningrad

[Abstract] An electric-spark method of coating was used, since this method has a number of advantages -- strength of bonding of the coating layer with the substrate, possibility of coating any metallic substrate, practically no heating of the entire part. The use of this method was tested for coating parts of electric vacuum devices, particularly copper anodes, with zirconium and titanium carbides. The possibility is shown of applying thin carbide layers to copper, molybdenum and nickel parts by the electric spark method. The coating layer is firmly bonded to the substrate and has a number of positive characteristics -- antidynatron and "blackening" properties, resistance to electron bombardment in a vacuum. Analysis of the test results of instruments with copper anodes coated with titanium carbide shows the possibility of effectively reducing the grid temperature and, consequently, the temperature of thermal currents from the grid. Furthermore, noise in the instruments is reduced, which is of particular significance for HF and UHF band radio transmitting equipment. Figures 3;
references 6: 3 Russian, 3 Western.

USSR

UDC 621.357.7:669.248.7

INVESTIGATION OF CONDITIONS FOR PRODUCING NICKEL-BORON-CHROMIUM COMPOSITION
COVERING ON GRADE 45 STEEL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 7-9 manuscript
received 14 Dec 75

SAMSONOV, G. V., ZHUNKOVSKIY, G. L., LUCHKA, M. V. and KENDRACHUK, M. V.,
Institute of Problems of Material Science, Academy of Sciences UkrSSR

[Russian abstract provided by the source]

[Text] A coating of Ni + B + Cr is produced on grade 45 steel by coprecipitation of nickel from a chloride electroplating solution that contains a suspension of finely dispersed particles of boron and chromium. An investigation is made of the influence of vacuum diffusion annealing of the coatings on their structure, composition and resistance to wear. It is found that nickel coatings with 3-4 wt.% boron and chromium show maximum resistance to wear when tested for boundary friction against chilled grade 45 steel.
Figures 3; references 5: all Russian.

USSR

UDC 621.914.22.025.7:661.65

FACE MILLING CUTTERS WITH BITS MADE OF COMPOSITE

Moscow STANKI I INSTRUMENT in Russian No 2, Feb 77 pp 9-11

BOROVSKIY, G. V., and MUZYKANT, YA. A.

[Abstract] Face milling cutters with bits made of variously modified composites have been developed at the All-Union Scientific-Research Institute of Tools. The cutters are designed for finishing machining of the surfaces of articles made of hardened steel or cast iron. The cutter has several removable bits. The composite is bonded to the bit by a powder metallurgy method or brazed to steel inserts. Two designs of the cutters are described -- the basic one and one with the increased number of cutting bits. The advantages of multi-bit cutters over one-bit cutters are shown. Results of experiments with new cutters are presented. Figures 6.

USSR

UDC 621.762.86:669.018.95

STRUCTURE AND PROPERTIES OF NICKEL-TITANIUM CARBIDE COMPOSITE MATERIALS MADE BY IMPREGNATION

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 6, 1976 pp 101-104
manuscript received 29 Dec 75

KIPARISOV, S. S., KOSTIKOV, V. I., NARVA, V. K. and TSEYTINA, I. L., Moscow Institute of Steel and Alloys, Department of Rare Radioactive Metals and Powder Metallurgy

[Abstract] A study is done on the structure and physicomechanical properties of composites based on titanium carbide and ZhS6K nickel alloy and made by the impregnation method. The ZhS6K alloy powder had the following composition in %: C--0.15, W--4.5, Mo--4.2, Ti--3.1, Al--5.6, Cr--11.6, Ca--5.0, Fe--0.8 and the remainder nickel. Carbonyl nickel containing 0.10% and 0.15% O₂ was also used. To make the porous blanks for impregnation, the titanium carbide powder was mixed with 6% nickel in alcohol in a ball mill for 24 hours. A 4% solution of synthetic rubber in gasoline was added to the dried mixture, and blanks were pressed at 0.25 metric ton per cm². The workpieces were sintered in vacuum at 1400°C for 30 minutes. The same method was used to make pure titanium carbide porous blanks. The workpieces were then impregnated with ZhS6K alloy by the contact method in vacuum at 1450°C for one hour. The degree of impregnation with molten alloy was 99-100% for blanks with nickel added, and 94-96% for blanks without the nickel additive. The composites made by impregnation of blanks with nickel added to the charge showed better physical and mechanical properties than those without the nickel additive at both room temperature and elevated temperatures (up to 900°C). Figures 3; references 11: 5 Russian, 6 Western.

USSR

UDC 621.9.025.7:661.65

TREATMENT OF HARD ALLOYS AND MELTS WITH CUTTING TOOLS OF HEXANITE-R

Moscow MASHINOSTROITEL' in Russian No 3, 1977 pp 24-25

BARABAN, V. P., POVOLOTSKIY, V. YU. and VINOGRADOV, G. B.

[Abstract] Hexanite-R cutting tools are being used with increasing frequency in metal treatment. These tools retain a sharp cutting edge under the most diverse conditions, thus making their utilization broad in scope. They are especially feasible for use on hard alloys and melts instead of diamonds and have a significant technico-economic effect. By increasing the volume of hexanite-R cutting tools, new areas of application will be found to facilitate improvement in quality and increase in effectiveness of the metal treatment.

USSR

UDC 539.4.015:019

CALCULATION OF THE STRENGTH OF NATURAL FIBER COMPOSITES BASED ON CARBON STEELS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 232, No 6, 1977 pp 1299-1301
manuscript received 5 Oct 76

STARODUBOV, K. F., Academician of the Academy of Sciences UkrSSR, FLOROV,
V. K., and DETSYURA, K. YA., Dnepropetrovsk Metallurgical Institute

[Abstract] Calculation of the strength of natural fiber composites created in carbon hypoeutectoid nonalloyed steels by plastic deformation of the metal after isothermal holding in the intercritical area of temperatures with subsequent hardening must be performed considering the variability of mechanical properties of fibers and of the matrix with changes in the volumetric content of the fibers. In the case of natural reinforcement by strengthening fibers, the fibers are extended as a result of plastic deformation of the austenite sectors, transformed upon hardening to martensite with a strength determined by the variable carbon content. Studies of the mechanical properties of the matrix as a function of the degree of deformation and temperature were performed on specimens of armco iron deformed by 20, 40 and 60% by one-time rolling and by 150% by repeated rolling with subsequent hardening after 3 hours' isothermal holding over a broad range of temperatures. The level of strength properties of the matrix was approximately the same for the degrees of deformation, indicating that the primary increase in strength of armco iron occurs with deformations of less than 20%, further increases in the degree of deformation not leading to a significant increase in strength. A volumetric diagram of the strength of reinforcing fibers as a function of intercritical temperature of isothermal holding is constructed. Thus, if we know the volumetric relationship of phases arising as a result of isothermal holding in the intercritical temperature area, construction of a three-dimensional strength diagram of natural composites with unidirectional continuous (or rather long) fibers can be used to determine the static strength of future natural composites created by deformation of steels in the intercritical temperature area after isothermal holding with subsequent hardening. Figures 2; references 12:
9 Russian, 3 Western.

USSR

UDC 621.048.7

EROSION STABILITY OF COMPOSITE MATERIALS BASED ON NITRIDES OF TITANIUM,
ZIRCONIUM AND ALUMINUM UNDER THE INFLUENCE OF A STREAM OF ELECTRONS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2 (170), Feb 77 pp 19-22
manuscript received 23 Apr 76

VERKHOTUROV, A. D., KUZENKOVA, M. A., SLUTSKIN, M. G. and KRAVCHUK, L. A.,
Institute of Problems of Material Science, Academy of Sciences UkrSSR

[Abstract] A study is made of the erosion resistance of composite material based on the nitrides of titanium, zirconium, aluminum, produced by powder metallurgy methods, with residual porosity of the specimens not over 5-7%. Throughout the entire range of concentrations, the materials were heterogeneous mixtures of two phases with lattice periods practically the same as that of the initial nitrides. The mechanism of rupture and erosion stability of the composite materials was studied under the influence of a stream of electrons in the spark and cathode ray methods of processing. It is shown that rupture of the substance by the stream of electrons is determined primarily by the rate and mechanism of evaporation of components of the composite materials. Figures 5; references 6: 5 Russian, 1 Western.

USSR

UDC 669.71

PRODUCTION OF SHEETS OF COMPOSITE MATERIALS WITH BRITTLE FIBERS WITHOUT RUPTURE DURING THE PROCESS OF ROLLING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 122-125 manuscript received 4 Aug 76

MANUYLOV, V. F., TIKHONOV, A. S., KATINOVA, L. V., GALAKHOV, A. V., SOKOLOV,
V. S., and PAVLOV, YE. A., Moscow

[Abstract] A theoretical study is made of the force and geometric conditions involved in high-temperature rolling of a composite material consisting of a metal matrix and a brittle fiber. Conditions were established for production of a high-quality joint between the matrix layers of aluminum and with the fibers of boron with minimal disruption of continuity of the fibers. The calculations are confirmed by the production of high-quality sheets of the composite material, achieving a high degree of reinforcement. Figures 3;
references 2: both Russian.

USSR

UDC 621.771.001:669.71

CALCULATION OF THE OPTIMAL COMPRESSIONS FOR SHEET ROLLING OF COMPOSITE MATERIALS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 117-121 manuscript received 13 Sep 76

TIKHONOV, A. S., MANUYLOV, V. F., GALAKHOV, A. V., and PAVLOV, YE. A.,
Moscow

[Abstract] Results are presented from analysis intended to determine compressions during sheet rolling of composite fiber materials. Based on the condition of formation of a strong bond at the fiber-matrix boundary, the total compression is calculated, and also modes of partial compression are defined for each pass of rolling of the composite material with superplastic matrix as applicable to the silumin-boron pair. The results of calculations are confirmed by experimental data. The rolled specimens had high quality bonding of the layers of the material to each other and to the fibers. The short-term tensile strength was 94-106 kg/mm², quite close to the theoretical strength of the composite at room temperature. Figures 4; references 4:
all Russian.

USSR

UDC 669.71:539.4

THE CREATION OF MATRICES OF HEAT-RESISTANT COMPOSITE MATERIALS WITH USAGE TEMPERATURE OF 1100°C

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 112-116 manuscript received 24 Feb 76

SHORSHOROV, M. KH., BANNYKH, O. A., DORONIN, I. V., ANTIPOV, V. I.,
TRUNIN, V. F., MAKARENKO, V. I. and RYBAL'CHENKO, M. M., Moscow

[Abstract] A study is made of the influence of alloying elements on the heat resistance of alloys based on nickel and iron, used as matrices for composite materials. The optimal content of tungsten, molybdenum, chromium and other elements for long-term and short-term hot strength at 1100°C is determined for the nickel-chrome alloys EP-496, EI-868, EI-652, EP-202, EP-795 and steels types Kh25N16G7AR, Kh12N20T3R, 1Kh13 and 4Kh13. Based on the data produced, industrial alloys are selected for the matrices of composite materials. Figures 2; references 5: all Russian.

Conferences

USSR

UDC 620.197.1:669.1

IMPROVING THE CORROSION RESISTANCE AND DURABILITY OF FERROUS METALS

Moscow STAL' in Russian No 12, Dec 76 pp 1126-1128

SALAMATOV, L. G.

[Abstract] A brief review is presented of the work of a session of the Scientific and Technical Council of the Ministry of Ferrous Metallurgy of the USSR held in May 1976. Reports were presented on ways to increase the corrosion resistance and service life of ferrous metals (S. A. Golovanenko, professor, doctor of technical sciences, Central Scientific Research Institute of Ferrous Metallurgy), development of steps to protect metals from corrosion (V. P. Batrakov, professor, doctor of technical sciences, State Committee of the Council of Ministers of the USSR on Science and Technology), low-alloy steel with increased resistance to atmospheric corrosion (D. A. Litvinenko, candidate of technical sciences, TsNIIchermet), production and developmental outlook in thin rolled sheet metal with protective coating (V. A. Paramonov, candidate of technical sciences, TsNIIchermet), the current state and outlook for development in production of corrosion-resistant bimets (A. A. Bykov, candidate of technical sciences, TsNIIchermet), the introduction of metallurgical intermediates with corrosion-resistant diffusion coatings (A. K. Petrov, candidate of technical sciences, Ukrainian Scientific Research Institute of Special Steels, Alloys and Ferro-alloys), and increasing the corrosion resistance and durability of pipes made from stainless and high-carbon steels (O. A. Semenov, candidate of technical sciences, All-Union Scientific Research Institute of Pipes). The council passed recommendations on expanding production of rolled stock of steel that is resistant to atmospheric corrosion, in particular type 10KhNDP, introducing equipment for diffusion chrome-plating strip steel, development of facilities for making corrosion-resistant bimets, production of chrome steels with especially low content of carbon and nitrogen, expanding production of low-carbon chrome-nickel austenitic steels, introduction of equipment for zinc-plating and heat-treating compressor pipes, organizing production of enameled and bimetal pipes, research and development on new corrosion-resistant steels, metal, polymer and varnish coatings, and further improvement of diffusion chrome-plating, electron-beam melting, electrostatic and electrophoretic application of aluminum, titanium, copper and other metals and alloys from powders, and production of bimets by the explosive method.

USSR

UDC 669.18-412:621.746+755(047)

ON THE SIXTH PLENARY SESSION OF THE SEMINAR "STEEL AND NONMETALLIC INCLUSIONS"

Moscow STAL' in Russian No 12, Dec 76 pp 1098-1100

KISELEVA, S. A., Central Scientific Research Institute of Ferrous Metallurgy

[Abstract] In July 1976, the Central Institute of Ferrous Metallurgy held its sixth plenary session of the seminar "Steel and Nonmetallic Inclusions" in Volgograd. The seminar was attended by 106 representatives of 18 research and design institutes and 17 plants and production associations. This session was devoted chiefly to the use of rare earths and alkali metals in metallurgy. Reports were presented and discussed on sources of raw materials for obtaining rare earths (V. D. Kosynkin, G. Ye. Kaplan, S. D. Moiseyev, I. I. Anufriyev), alloys with rare earths and alkali metals, and effective ways of making them (A. N. Morozov, I. V. Ryabchikov), regions of application of rare earths in metallurgy (V. P. Averin, A. N. Morozov, V. D. Kosynkin), microdoping steel with rare earths and alkali metals during teeming (A. P. Grishin, Ye. I. Tyurin, V. F. Chistyakov, M. N. Kul'kova, V. V. Averin, S. M. Polonskaya, L. S. Rybkina), improving the quality of converter steel by modifying with rare earths and alkali metals (V. V. Lunev, Yu. A. Shul'te, V. N. Andryushenko), adding rare earths to weld metal (Yu. I. Rubenchik, A. P. Okenko), the effect of magnesium on the structure and properties of high-temperature alloys (V. V. Topilin), the influence of the nature and morphology of inclusions on the machinability of steel (Ya. Ye. Gol'dshteyn, A. N. Morozov) and the relation between machinability and the content of sulfur, selenium and lead in steel (F. V. Malev, G. D. Gromyko).

USSR

UDC 621.791:061.3

SCIENTIFIC AND TECHNICAL CONFERENCE ON THE EFFECTIVENESS OF MECHANIZATION
OF THE PRODUCTION OF WELDED STRUCTURES

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 77 pp 76-78

LIPOVICH, G. A. and SNEZHKO, V. I.

[Abstract] The All-Union Scientific and Technical Conference on the theme "Effectiveness of the Application of Mechanization and Automation in the Production of Welded Structures" was held in Taganrog 7-8 October 1976. Some 130 representatives of 95 enterprises, organizations and educational institutions of the country attended, hearing 24 reports. Subjects covered by the reports included the prerequisites for development of combined mechanization and automation of the production of welded structures; the

effectiveness of combined mechanization of the manufacture of welded units; methods of determining areas of economically effective application of mechanized methods of welding of high-strength steels in enterprises in heavy and power machine building; methods of calculation of adjustment factors for determination of the indicators of combined mechanization of the manufacture of welded structures; means for increasing the effectiveness of production of welded structures for self-propelled type SK-5 combines; the effect of automation of the process of strengthening of working organs in agricultural equipment; the principles and design of programs for the process of welding of parts by a mobile electric riveting machine; popularization of effective means and methods of mechanization of the manufacture of welded structures in the press; means for increasing the productivity of labor; and some individual new equipment recently put on stream.

USSR

UDC 621.791:061.3

IN THE COORDINATION COUNCIL ON WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 77 p 74

FEDORENKO, YA. A.

[Abstract] On 27-29 October 1976 a session of the Coordination Council on Welding and the Scientific Council on the problem "New Processes of Welding and Welded Structures" of the State Committee of the Council of Ministers USSR for Science and Technology was held. The session was divided into the following sections: "Technology of Welding," "Welding Equipment," "Economics and Organization of the Production of Welding," "New Processes in Welding," "Welding Structures," "Soldering of Materials," "Welding of Light, Nonferrous and Refractory Metals," "Surfacing and Related Processes," "Training of Scientific and Engineering Personnel for the Performance of Welding," "Scientific-Technical Information and Literature on Welding," and a temporary commission on "Mathematical Methods of Investigation." The sessions dealt with problems of increasing the effectiveness and quality of the performance of welding and saving of metal. In addition to the scientific reports, suggestions were discussed for scientific research, planning-design and engineering development in the area of welding science and technology for 1977. The session approved a summary plan for scientific research, planning-design and engineering development in the area of welding science and technology for 1977, approved the All-Union plan for conduct of conferences and meetings on welding and a plan schedule for preparation of materials for a review of the development of welding in the USSR in 1976.

Corrosion

USSR

UDC 669.14.018.2:539.43

METALLOGRAPHIC STUDY OF THE RUPTURE OF TYPE 15KhN3DMA STEEL IN SEA WATER
UNDER LOW CYCLE FATIGUE LOADING

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 70-73 manuscript received 24 Dec 75

KOBZARUK, A. V., Institute of Physico-Mechanics, Academy of Sciences UkrSSR,
L'vov

[Abstract] This study was undertaken for a deeper evaluation of the strength properties of type 15KhN3DMA steel, including a study of the kinetics and nature of rupture of this material under low-cycle loading in sea water at stresses near the yield point and higher. Smooth, flat specimens were subjected to bending with relative deformations of 0.5, 1.25 and 1.75%. The relative deformation corresponding to the bending yield point was then determined as 0.62%; consequently, cyclical deformations were $0.8 \epsilon_{0.2}$, $2\epsilon_{0.2}$ and $2.8\epsilon_{0.2}$. The studies performed indicated that surface-active and corrosive media (see water) help to accelerate intragrain shear deformation and change the microrelief of the surface of the specimen (in this case manifested as slipping bands and Chernov-Luders lines), causing the appearance of fatigue cracks. For the steel tested, these cracks are transcrystalline in nature, as in the case for testing in air. Sea water causes the cracks, while remaining transcrystalline, to branch like cracks observed in the presence of distilled water in ordinary fatigue, the ends of the cracks generally being broad and blunt. References 9: 7 Russian, 2 Western.

USSR

UDC 620.171.3+620.193.28

STUDY OF THE LONG-TERM STRENGTH OF EP-199 ALLOY AND ITS WELDED JOINTS IN
THE PRODUCTS OF DECOMPOSITION OF AMMONIA

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 67-69 manuscript received 28 Apr 76

BICHUYA, A. L., OSERED'KO, A. S., VOZNYY, T. D. and GRIDNEV, O. V.,
Institute of Physico-Mechanics, Academy of Sciences UkrSSR, L'vov

[Abstract] Studies were made of the long-term strength of EP-199 alloy and its welded joints in a stream of ammonia. The tests were conducted on a special installation using tubular specimens 10 mm in diameter. Tests were performed at 700, 800 and 900°C in a vacuum of $2 \cdot 10^{-5}$ torr and in a stream of ammonia at 0.01 g/s (ammonia fed inside tubular specimens). The results showed that EP-199 is practically unusable at 900°C, long-term strength with

a test base of 100 hr being 3 kg/mm^2 , relative elongation 200%. Metallographic study of specimens tested in a vacuum, hydrogen and ammonia, showed that as load is applied, there is slight growth of the grains of the alloy, particularly at grain boundaries and points of separation of inclusions. Judging from the characteristics of fracture of the specimens in a vacuum and in hydrogen, one primary crack develops during loading, leading eventually to rupture. When ammonia acts on the surface of the specimens, a network of cracks develops, characteristic for the rupture of metals in surface-active media, with no development of nitride layers on the surface of internal nitrided specimens in ammonia and hydrogen shows that the factor which controls long-term strength at 800°C is the adsorption influence of ammonia. Figures 1; references 13: 11 Russian, 2 Western.

USSR

UDC 669'71:669.046.42.001

THE EFFECT OF TUNGSTEN ON THE OXIDATION OF TITANIUM ALLOYS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 232, No 4, 1977 signed to press 5 Jul 76 pp 863-866

LAZAREV, E. M., KORNIKOVA, Z. I. and UGASTE, YU. E., Institute of Metallurgy imeni A. A. Baykov, Academy of Sciences USSR, Moscow

[Abstract] Titanium, being chemically active, is not thermally stable, and the problem of raising its heat-resistance in a significant degree is a serious one, which at the present time yields best to multicomponent alloying or to the application of protective coatings. Available experimental data on the gas corrosion of titanium-tungsten and titanium-tungsten-aluminum alloys already indicate a significant rise in the oxidation-resistance of those substances, due precisely to the presence of tungsten: their heat-resistance at 800 - 900°C is close to that of nickel-chromium alloys. On the other hand, some published data suggest a negative effect of tungsten in the oxidation-resistance of titanium (1955, 1964). To clarify the point, the authors studied the oxidation kinetics of titanium-tungsten in air with varying content of tungsten (0.6, 3, 5, 7, 10, 15 and 25 percent by weight), the testing air temperature being 800 and $1,000^\circ\text{C}$. At 800°C , heat-resistance of the alloys increased sharply when the tungsten content was raised to about 3-5%, then remained almost constant in the 7-25% content range. At $1,000^\circ\text{C}$, minimal oxidation rates were observed with alloys having 7-15% by weight of tungsten. It is concluded that the significant increase in heat-resistance in tungsten-alloyed titanium alloys (and, consequently, also in their temperature range for practical use) is due to reduction in the solubility of oxygen in the sub-scale layers, and also to reduction in the diffusion permeability of the scale (rutile) during alloying with tungsten. Figures 1; tables 1; references 14: 6 Russian, 8 Western.

USSR

UDC 620.194

STUDY OF THE INFLUENCE OF CORROSION ON DURABILITY OF GAS TURBINE BLADES

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 55-57 manuscript received 21 Oct 74

CHUPRINA, V. G., TRET'YACHENKO, G. N. and KONEV, V. A., Institute of
Problems of Strength, Academy of Sciences Ukr., Kiev

[Abstract] A study was made of the influence of high-temperature gas corrosion on the durability of gas turbine blades. The conditions of use of the blades were modeled using a special gas dynamic test stand. The experiments were performed on actual blades made of chrome-nickel alloy type EI-868 (nickel plus 0.09%, C, 0.46% Si, 0.25% Mn, 25.58% Cr, 0.52% Ti, 0.94% Mo, 14% W, 0.23% Al and 2.85% Fe). They were tested in an atmosphere consisting of the combustion products of kerosene in air with salts from sea water and with no salts with a cyclical change of gas stream temperature between 1050 and 700°C. Total cycle length was 15 s, including 5 s of heating, 10 s of cooling. Gas stream velocity was 0.7-0.8 M. The tests established that introduction of the salts from sea water at 1, 5 and 10 mg per m³ of gas reduced the durability of the blades by 4.5, 8.0 and 20 times respectively. At first, the blades oxidize slowly due to the good protective properties of the oxides of nickel and chromium, but as the number of thermal cycles increases, microscopic defects accumulate in the surface layers, intensifying diffusion processes and causing an increase in oxidation rate. References 5: all Russian.

Extraction and Refining

USSR

UDC 622.777:669.213

USE OF ELECTRIC SEPARATION FOR EXTRACTION OF GOLD FROM ORES

Moscow TSVETNYYE METALLY in Russian No 2, Feb 77 pp 79-82

TARASOVA, T. B. and ZAMYATIN, O. V.

[Abstract] Gold is a good conductor of electricity: its conductivity and the conductivity of the sulfides with which it is associated in most ores are significantly greater than the conductivity of the accompanying gangue minerals. This indicates that gold-containing ore may be a raw material favorable for beneficiation by electric separation. A high rate of extraction of gold from the ores studied by electric separation was achieved: 93.6-6-95.0%. The maximum quantity of gold after the first stage of grinding was extracted from quartz ore, which also yielded the highest degree of concentration of gold. Nearly the same degree of concentration was achieved upon beneficiation of quartz-sulfide ores. The beneficiation of quartz-sulfide polymetallic and quartz-shale ores is significantly lower, achieving gold concentration factors of 11 and 5 as opposed to 19 for quartz ore. Analysis of the tailings showed that most of the gold present (63-89%) is either free but in grains smaller than 0.05 mm in diameter or in aggregates, or in close association with sulfides. This indicates that more gold could be extracted from the tailings in later stages. The studies showed the possibility of using electric separation for effective beneficiation of certain gold-containing ores, where the gold is in nuggets larger than 0.04 mm in diameter, or associated primarily with conducting ore minerals greater than this diameter, where the quantity of conducting minerals is not great and where components reducing the effectiveness of electric separation are not present in high concentrations. Figures 3.

Graphite

USSR

UDC 621.039:532.21

RELATIONS BETWEEN STRENGTH CHARACTERISTICS IN IRRADIATED GRAPHITE

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 95-100 manuscript received 16 Jan 76

VIRGIL'YEV, YU. S., MAKARCHENKO, V. G. and CHURILOV, YU. S., Institute of Problems of Strength, Academy of Sciences UkrSSR

[Abstract] Graphite materials are studied for the influence of neutron bombardment on strength characteristics: modulus of elasticity, Brinell hardness, tensile, bending and compression strengths, and the relation among them. The materials studied were medium-grained artificial graphites based on grade KNPS metallurgical coke (GMZ, VPG and KPG). These materials have exceptionally high strength characteristics. Accumulated doses under neutron exposure ranged from about $4 \cdot 10^{18}$ to $6 \cdot 10^{20}$ neutrons/cm². Neutron energy was more than 0.18 MeV. Temperature ranges during exposure were 80-100, 120-150, 200-300 and 400-450°C. The results show that radiation hardening of high-strength graphites VPG and KPG begins at doses of a few times 10^{18} neutrons per cm². GMZ graphite, which is not as strong, must accumulate a dose of about $(1-2) \cdot 10^{19}$ neutrons/cm² before the onset of the hardening effect. As the irradiation temperatures increases, hardening begins at heavier doses. All characteristics reach saturation and level off after accumulation of a certain neutron dose. The ratios between the various properties of the specimens before exposure are retained after exposure within about 8%. Figures 5; references 9: 7 Russian, 2 Western.

USSR

UDC 539.377:666.896

PHYSICOCHEMICAL PROPERTIES OF SILICIFIED GRAPHITES

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 88-94 manuscript received 3 Mar 75

BARABANOV, V. N. and TARABANOV, A. S., Moscow

[Abstract] The authors consider methods of increasing the strength of graphite materials by reducing porosity and eliminating cracks, in particular by the process of silicification. This technique provides a range of materials with properties varying from those of pure graphite to those of pure silicon carbide. Factors that influence the properties of silicified graphites are considered, specifically the total volume of pores, the nature of the porosity and the distribution of pores throughout the material, and also the silification process, the final silicon carbide content, the amount of silicon and carbon, and the way that these structural components are

distributed in the material. In general, mechanical properties are directly proportional to the impregnation of the initial graphite material with silicon. The main reasons for the increased strength of the impregnated material are reduction in macrostructural nonhomogeneity, reduction of overall porosity, rounding of pores and the tips of cracks, formation of silicon carbide on the surfaces of cracks and pores, closing of cracks, silicon carbide hardening of the surfaces of grains and the bridges between grains, and the formation of a continuous silicon carbide matrix. Tables are given showing the mechanical properties of silicified graphites as determined by the degree of impregnation, testing temperature and the number of heating and cooling cycles. Comparative data are given on the resistance of silicified graphite materials to thermal cycling. The mechanical properties of series produced materials in this class are summarized for temperatures from 20 to 2800°C. Figures 3; references 2: both Russian.

Heat Treatment

USSR

UDC 669.14.018.292

INFLUENCE OF HEAT TREATMENT SCHEDULES ON THE RESISTANCE TO DEFORMATION AND THE BREAKING STRENGTH OF 30KhGSA STEEL

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 101-106 manuscript received 10 Sep 75

LAZ'KO, V. G., KARCHEVSKAYA, N. I. and OVSYANNIKOV, B. M., Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Abstract] The authors study the influence of quenching from the ferrite-austenite zone on the resistance to deformation and the breaking strength of 30KhGSA steel with the following chemical composition (in %): 0.29 C, 1.1 Si, 0.9 Mn and 1.0 Cr. Primary quenching was from 900°C (holding at 20°C, cooling in oil). Secondary quenching was from the "intercritical" region of 700-860°C with subsequent annealing at 200°C. The result was two-phase (ferrite-martensite) steel with a content ratio of phases depending on the secondary quenching temperature. Mechanical tests of the heat-treated steel showed that quenching from the ferrite-austenite zone gives strength close to that of the steel after conventional quenching, but with much higher breaking toughness. The optimum structure is heterophase with 5-10% of the second ("soft") phase. After secondary quenching from 740°C, the toughness characteristics of 30KhGSA steel with the same strength increase by 50% or more as compared with the same steel when quenched and annealed at 650°C. Figures 6; references 12: all Russian.

Productivity in kg of granules per hour	15-18
Average consumption of electric energy per kg of granules, kW/hr	5-6
Water flowrate, m ³ /hr	~1.5
Flowrate of inert gas (argon, helium), m ³ /kg of granules	~0.04
Size of the installation (without the power supply) with vacuum pump, m height	3.4
area	4.0x4.0

Instrumentation and Equipment

USSR

UDC 669.721

DIAPHRAGMLESS ELECTROLYZERS FOR MAGNESIUM PRODUCTION AND THEIR ADVANTAGES

Moscow TSVETNYYE METALLY in Russian No 1, Jan 77 pp 49-50

DONSKIKH, P. A.

[Abstract] Data are given on diaphragmless electrolyzers in which the cell feed is nonaqueous fused carnallite with anodes led in from below, and on similar units with molten magnesium chloride cell feed and overhead suspension of the anodes where the cathodes are the framework type. The anodes are made up of two graphite bars in a cast iron casing. Comparative data are given on the working indices of equipment of the diaphragm and diaphragmless type for electrowinning magnesium. It is found that the diaphragmless type uses less electric energy per ton of magnesium, and gives a higher yield of chlorine. Figures 2.

USSR

AN INSTALLATION FOR MAKING METAL GRANULES

Moscow METALLURG in Russian No 1, Jan 77 p 48

[Text] The installation produces metal granules of true spherical shape 50-1500 μm in diameter from titanium, zirconium, molybdenum and other metals. The spherical granules are used to make monolithic articles, insulation materials and high-quality filters. In contrast to similar conventional units, this installation is equipped with a magazine for consumable electrodes with semiautomatic replacement without breaking the seal on the device. The magazine can be made to accommodate any given number of consumable electrodes. The feed mechanism of the installation uses electrodes in a wide range of sizes: 50-200 mm in diameter and 500-2000 mm long. The design provides for increasing the dimensions of consumable electrodes even further. Granules made on this unit from refractory titanium, nickel and cobalt alloys are suitable for making pipes, complex structural shapes and especially for the strength members of gas turbine engines. Tool steel granules can be used to make cutting tools by the powder metallurgy method. Filters made from titanium granules are especially useful for ultracleaning of sea water before desalination, in production of artificial fiber, and in the petrochemical, food and other branches of industry. The filters have high corrosion resistance, constant flowthrough, and are easily regenerated by pressurized reverse flow of hot water. Filters can be made with any desired degree of filtration fineness.

USSR

UDC 539.4:678

AN INSTALLATION FOR STUDYING THE MECHANICAL PROPERTIES OF NONMETALLIC MATERIALS IN THE TEMPERATURE RANGE FROM +600 TO -190°C

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 121-124 manuscript received 28 Oct 75

ALEKSYUK, M. M., OVDEY, M. N., PETRENKO, A. I., LOKSHIN, V. A., and DUBINA, M. D., Institute of Problems of Strength, Academy of Sciences UkrSSR

[Russian abstract provided by the source]

[Text] The paper describes an installation for determining the strength and deformability of nonmetallic materials under tension, compression, bending, shear, buckling, and also the strength of glued joints when specimens are heated by hot air to 600°C and cooled by liquid nitrogen vapor to -190°C. The installation is more universal than conventional units of this kind and has higher test productivity. Figures 4; references 5: all Russian.

Magnesium

USSR

UDC 669.721

MAGNESIUM REFINING

Moscow TSVETNYYE METALLY in Russian No 1, Jan 77 pp 51-54

LEBEDEV, O. A., MUZHZHLEV, K. D. and KORZUN, V. P.

[Abstract] It is shown that current technology cannot further reduce the content of iron, silicon and aluminum in the primary magnesium produced by electrowinning fused salts. A comparative analysis is made of methods for further refining the magnesium recovered from the electrolyzer. Particularly advantageous is a three-layer electrolytic refining process resulting from research at the All-Union Scientific Research Institute of Aluminum and Magnesium and the Solikamsk Magnesium Plant. The impurity content of the cathode metal in this process is on a level with that of the sublimed metal, being (in % by mass): <0.0002 Cu, <0.0024 Mn, <0.0016 Zn, 0.0018 Si, 0.005-0.009 Al, <0.0042 Fe, and 0.001 Pb. As compared with other processes of ultrarefining, the proposed technique has the following advantages: it is possible to remove practically all impurities from magnesium; the process is continuous; equipment and operations are simple; and raw magnesium can be used as the anode metal. Preliminary studies show that the cost of the refined magnesium should be only 25% higher than that recovered by electrowinning. References 8: 6 Russian, 2 Western.

USSR

UDC 669.721:621.74

ANALYSIS OF THE FEATURES OF HORIZONTAL CONTINUOUS CASTING OF MAGNESIUM

Moscow TSVETNYYE METALLY in Russian No 12, Dec 76 pp 43-45

VYATKIN, I. P. and CHUKHROV, M. V.

[Abstract] The authors examine some features of horizontal continuous casting of magnesium with preferential heat removal through the ingot and continuous withdrawal. The forces acting in horizontal continuous casting are analyzed on the basis of the vector method. It is shown that the forces in the horizontal case are asymmetric, and that shifting of the thermal axis causes asymmetric cooling also. It is concluded that an asymmetric mold must be used to balance out the heat fluxes away from the ingot in different directions. The water pressure must be held at a level of 1.5-2 times that used in vertical continuous casting to achieve the same cooling effect. Cooling can also be equalized by installing an auxiliary cooling system after the outlet from the mold. Figures 5.

Mechanical Properties

USSR

UDC 669.35:620.1

INFLUENCE OF GRAIN SIZE ON MECHANICAL PROPERTIES OF HIGH PURITY COPPER

Moscow TSVETNYYE METALLY in Russian No 2, Feb 77 pp 60-62

TSYPIN, M. I., BRABETS, V. V. and AFONIN, M. P.

[Abstract] A study is made of the dependence of mechanical properties of high-purity copper (99.994% Cu) on initial structure, particularly grain size. It was found that deformation and rupture of copper specimens at high temperatures are determined to a certain extent by the difference in the nature of grain-boundary segregations of impurities in specimens with small and large grains. As grain size decreases, the "power" of grain-boundary segregations decreases (in proportion to $1/d$). The mobility of grain boundaries increases, and the ductility of the fine-grain material is higher than that of coarse-grain material. Figures 3; references 8: 6 Russian, 2 Western.

Powder Metallurgy

USSR

UDC 621.762:669.245

PRODUCTION OF DISPERSION HARDENED NICKEL-CHROMIUM ALLOY BY MECHANICAL ALLOYING

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2 (170), Feb 77 pp 53-57
manuscript received 15 Dec 75

BABICH, B. N., KOLUPAYEVA, S. YA., KUSTOV, YU. A., CHERNYAK, A. I. and SHCHETANOV, B. V., All-Union Scientific Research Institute for Aviation Materials

[Abstract] A study is made of the possibility of using the process of mechanical alloying for the production of a dispersion hardened alloy with the composition Ni + 20% Cr + 2.4% HfO₂. Highly energetic mixing in a planetary centrifugal mill provides for homogenization, the rate and depth of which are related to the processing conditions -- degree of filling of the volume of the mill with balls and ratio of their mass to the mass of the powder mixture. Semifinished goods of powders produced by mechanical alloying have higher homogeneity of structure than when simple mixtures of components are used, feature more complete recrystallization and, as a result, show better mechanical properties in high temperature tests.

Figures 4; references 6: 1 Russian, 5 Western.

USSR

UDC 621.762:620.193

INFLUENCE OF TECHNOLOGICAL FACTORS ON THE MECHANICAL PROPERTIES OF SINTERED TiC-Ni-Co-Cr ALLOYS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 11-16
manuscript received 6 Jan 76

VAL'DMA, L. E., KUDRYAVTSEV, V. A. and KALLAS, P. K., Tallinn Polytechnical Institute

[Abstract] Because of its high resistance to wear, scaling and heat, titanium carbide is used as a component in high-temperature materials. The properties of sintered hard alloys containing TiC are influenced by a number of technological factors. The authors use the technique of mathematical planning of experiments to determine how the properties of the alloys depend on time of pulverization, amount of binder, graphite content in the charge, sintering temperature, heating rate, cooling rate and isothermal holding time. Regression equations are given that describe the influence of these factors

on grain size of the carbide phase, hardness, resistivity, density, bending strength, elastic modulus, impact toughness and resistance to abrasive carbon. The specimens were made under a pressure of 1 metric ton per sq. cm, with preliminary sintering at 700°C in hydrogen and final annealing in a vacuum of $5 \cdot 10^{-3}$ mm Hg. The ratio of binder components was Ni:Co:Cr = 4:3:1. The results of the study show that technological factors in making sintered hard alloy based on TiC with a binder of Ni-Co-Cr can produce changes in static strength by a factor of 1.5-2, in dynamic strength by a factor of 3, and resistance to abrasive and hydroabrasive jet wear by a factor of 2-4. Figures 1; references 11: 10 Russian, 1 Western.

USSR

UDC 621.762

EXPERIENCE IN PRODUCING AND USING SINTERED FRICTION ARTICLES FOR FRICTION UNITS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 97-101
manuscript received 15 Sep 74

MIGUNOV, V. P., IVANOV, YE. V. and MOKINA, G. P., All-Union Scientific Research Institute of Aviation Materials

[Abstract] An investigation was made of the influence of different grades of initial components on the friction characteristics and wear of FMK-8, FMK-11 and MKV-50A sintered friction materials. The purpose of the study was to determine the feasibility of using more plentiful materials in series production of these compositions. It was found that satisfactory materials can be made with cheaper grades of iron powder, asbestos, graphite, boron carbide and silicon carbide. These findings have been reflected in new specifications for initial materials for the FMK-11 and MKV-50A sintered compositions used in making sectors and disks. Figures 3.

USSR

UDC 621.762

SELF-LUBRICATING COMPOSITE MATERIALS AND THEIR FRICTION CHARACTERISTICS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 78-82
manuscript received 13 Oct 74

FEDORCHENKO, I. M., POPCHENKO, YU. A., ZABOLOTNYY, L. V., KOLESNICHENKO, L. F., SLYS', I. G. and KLIMANOV, A. S., Institute of Problems of Material Science, Academy of Sciences UkrSSR

[Abstract] The authors consider composite materials made up of alternating bands of strength members and lubricant members. The components studied were normalized structural steels, stainless steels and tool steels grades 45, Kh18N9T, Kh23Kh18 and R18 as the strength members, and a silver-copper-zinc-cadmium alloy -- PSr40 silver solder -- as the lubricating member. The specimens tested were based on structural and tool steels with a combined working layer, or were materials of a matrix type, or were specimens with a built-up layer of silver alloy filled with particles of R18 tool steel. The friction properties were studied in couples with the composite material as the bearing and 38KhMYuA steel in the quenched state and VT14 with nitrided surface as the shaft in vacuum, in air without lubricant and with periodic feeding of UNIOL-1 lubricant into the friction zone. The results show that composite materials with heterogeneous structure having PSr40 silver alloy as a solid metal lubricant are highly effective under conditions of dry friction in vacuum and with restricted lubrication in air.

Figures 2; references 5: all Russian.

USSR

UDC 621.762

MANUFACTURING TECHNIQUE AND PROPERTIES OF FRICTION MATERIAL FOR ELECTRO-MAGNETIC CLUTCHES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 75-77
manuscript received 30 Nov 74

KACHANOVSKAYA, L. T. and VINOKUROV, V. I., All-Union Scientific Research Institute of Aviation Materials

[Abstract] A study is made of the production and properties of FMKM-1 friction material for use in electromagnetic clutches without lubricant. Optimum sintering pressure is 10 kg/cm², and optimum temperature is 810°C with holding for 3 hours. Studies of the microstructure show that the base of the alloy is a solid solution of copper and tin with inclusions of graphite, silicon dioxide, lead and molybdenum trioxide. Tests in the

ETM-071B clutch showed that the friction properties of FMKM-1 are superior to those of MK-5. The material shows the greatest wear resistance when working in a couple with 65G surface-ground steel. Figures 3; references 3: all Russian.

USSR

UDC 621.762

INFLUENCE OF SOME OPERATIONAL FACTORS ON THE CHARACTERISTICS OF MATERIALS IN FRICTION UNITS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 66-69
manuscript received 25 Nov 74

GERMANCHUK, F. K., DOKUCHAYEV, V. G., MARTYNOVICH, V. V. and CHAKHAROVSKIY, I. T., Kiev Institute of Civil Aviation Engineers

[Abstract] An investigation is made of the influence of various operational factors on the characteristics of friction materials with consideration of the pulsating action of antiskid systems in landing-gear brakes. FMK-11 sintered friction material was tested against ChNMKh alloys cast iron at sliding rates of 0.1-12.5 m/s at specific pressure of 15 kg/cm², with and without pulsating loading. The results show that frequency loading has less effect on the wear of iron than on that of the sintered material. An appreciable change in the coefficient of friction with frequency loading is observed only at low sliding rates. The maximum reduction in wear resistance of FMK-11 friction material with frequency loading (3.5 Hz) is observed at sliding rates of 2.0-8.0 m/s. Figures 3; references 7: all Russian.

USSR

UDC 621.762

INVESTIGATION OF THE PROPERTIES OF SINTERED FRICTION MATERIALS UNDER THE ACTION OF EXTERNAL MEDIA

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 62-65
manuscript received 25 Nov 74

GERMANCHUK, F. K., SKRIPKA, V. F., PYATNITSKIY, I. YE. and CHEKHAROVSKIY, I. T., Kiev Institute of Civil Aviation Engineers

[Abstract] Studies are done to improve the operating characteristics of the friction elements of landing-gear brakes made from sintered materials

by reducing the intensity of oxidative processes that occur during braking. The studies were done at sliding rates of 0.1-15.0 m/s under a constant load of 15 kg/cm² on friction materials FMK-11, FK-16L and MKV-50A against ChNMKh cast iron in different media. It was found that the working properties of FMK-11 friction material are most noticeably improved under the action of nitrogen-containing media: ammonia gas, or an aqueous solution of ethyl "Cellosolve" and organic amines. These media increase and stabilize the coefficient of friction at temperature about 400°C, which is important for high-load braking action. Wear of the FMK-11-ChNMKh friction couple is considerably reduced at temperatures between 800 and 1000°C. Figures 3; references 4: all Russian.

USSR

UDC 621.762

INFLUENCE OF METHOD OF INTRODUCTION OF CHROMIUM TO TITANIUM CARBIDE-STEEL ALLOYS ON THEIR PROPERTIES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2(170), Feb 77 pp 49-52
manuscript received 16 Feb 76

KIPARISOV, S. S., NARVA, V. K. and SELIVERSTOVA, O. V., Moscow Institute of Steels and Alloys

[Abstract] A study is made of the influence of the method of introduction of chromium to titanium carbide-steel alloys (30-50 wt. % TiC) in the form of powdered chromium and type FKh006 ferrochrome on their properties. The pressed specimens were vacuum sintered (10^{-4} mm Hg). The optimal sintering temperature was determined by testing the relative density of the specimens produced. Specimens were cooled after sintering at 25°C/min. The sintered materials were heat treated (annealing, hardening, tempering) in hydrogen. The influence of various modes of grinding of ferrochrome was studied: in a ball mill, vibration mill in alcohol and acetone, and in a planetary mill. It is found that grinding in the planetary mill for 30 minutes produces the highest quality grinding of the ferrochrome: 90% fraction less than 200 μm. Optimal conditions of production of TiC-Kh12M steel materials are established by introduction of the chrome to the composition of the steel in the form of ferrochrome powder: pressing pressure 3 t/cm², vacuum sintering temperature 1430-1470 C, sintering time 1 hour, heat treatment. The properties produced are practically the same as those when pure chromium is used, but the cost of production of the alloy is significantly lower. Figures 2; references 4: 3 Russian, 1 Western.

Single Crystals

USSR

UDC 669.28

INFLUENCE OF ZONE MELTING CONDITIONS ON THE SUBSTRUCTURE OF MOLYBDENUM SINGLE CRYSTALS

Moscow TSVETNYYE METALLY in Russian No 2 Feb 77 pp 46-47

KOLCHIN, O. P., NEDELYAYEVA, L. P., ROMASHOV, V. M. and TOLSTUNOV, A. V.

[Abstract] Contamination of the atmosphere in melting chambers by vapors of the working fluids in exhaust pumps reduces the quality of molybdenum single crystals produced by crucibleless cathode ray zone melting. The authors therefore studied the influence of evacuation conditions and the degree of contamination of the atmosphere on the substructure of molybdenum single crystals. It was found that in order to produce molybdenum single crystals of good structural quality, a high degree of purification of the atmosphere of the metling chamber must be achieved, removing virtually all of the vapors and products of decomposition of oils used in the vacuum pumps.

Steels

USSR

UDC 620.18:539.376.664.14

DESTRUCTION OF 12Kh1MF STEEL WITH CREEP IN THE RANGE OF TEMPERATURES CLOSE TO HALF THE MELTING POINT

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 6, Dec 76
pp 1281-1287 manuscript received 12 Feb 76

BEREZINA, T. G., ASHIKHMINA, L. A. and KARASEV, V. V., "Chelyabenergo"
Regional Power Administration

[Abstract] The particulars of onset and growth of micropores in 12Kh1MF steel are studied during high-temperature creep at temperatures close to half the melting point by methods of optical and transmission microscopy and fractography. It is found that micropores arise in the initial stages of creep. They are clearly observable in the second stage of creep, which is direct confirmation of the kinetic mechanism of the process of destruction. The way that the micropores are situated shows that they originate by some known dislocation mechanism. A considerable number of micropores arise where several sub-boundaries intersect, or where sub-boundaries are intersected by a wide-angle boundary. This indicates that the mechanism responsible for development of micropores is mainly pinning of dislocations. The form and location of the micropores during growth shows that size increase is due to a combination of diffusion and dislocation processes. Another important mechanism in pore growth is the opening of the pore due to slippage of boundaries. An indication of this mechanism is the fact that the growth and accretion of micropores up to 1-5 μm in size that are observed on the third stage of creep takes place only at grain boundaries, although up to 30% of the micropores arise at sub-boundaries on the second stage of creep. Merging of pores becomes important as a growth mechanism on the third stage of creep. Creep transition to the critical phase coincides with accumulation of a certain pore density and the onset of merging of pores into microcracks. Figures 5; references 16: 12 Russian, 4 Western.

USSR

UDC 669.183.0

SOME FEATURES OF THE INTERACTION BETWEEN OXYGEN AND FREELY FALLING DROPS OF MELTS OF Fe-C, Fe-Mn AND Fe-Mn-C

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 1, 1977 pp 53-57 manuscript received 15 Sep 76

YAVOYSKIY, A. V., AMEYA SAAD EL' DIN, SIGACHEV, A. A. and RUZHICHKA, V.,
Moscow Institute of Steel and Alloys

[Abstract] The Moscow Institute of Steel and Alloys and the All-Union Scientific Research Institute for the Planning and Design of Metallurgical

Machinery are currently doing research on jet refining for continuous steel smelting based on naturally alloyed cast iron. In this article the authors discuss the feasibility of using this technique to work high-manganese iron obtained from the Kremikov Deposit in Bulgaria, containing 8-10% Mn. Conditions of oxidative processes in jet refining were simulated in the laboratory by the falling drop method. The time of interaction with oxygen was varied from 0.1 to 0.4 seconds by increasing the height of the fall. The initial materials were synthetic alloys of Fe-1.2% C, Fe-1.8% C, Fe-4% Mn, and also manganese iron with the following composition: 4.0% C, 9.30% Mn, 1.68% Si, 0.15% P and 0.01% S. The results of the study showed two possible ways of working manganese iron by the jet refining technique. 1. Working the iron at atmospheric pressure with initial temperature of 1350-1450°C for maximum oxidation of manganese to slag and maximum retention of carbon in the metal. This gives pig iron with manganese and carbon content close to that ordinarily used for steelmaking. The resultant manganese slag can be used as raw material for ferromanganese or silicomanganese. 2. Low-pressure refining that maximizes decarbonization while retaining manganese in the metal. This technique results in naturally alloyed steels such as type G13 being produced directly from the pig iron or by mixing the manganese intermediate with low-carbon alloys. Figures 3; references 14: 6 Russian, 8 Western.

USSR

UDC 621.669.127

SINTERED HIGH-SPEED STEEL WITH TITANIUM CARBONITRIDE ADDITIVES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 1(169), Jan 77 pp 41-47
manuscript received 1 Oct 75

KIPARISOV, S. S., MEYERSON, G. A., PANOV, V. S., SMIRNOVA, M. M. and
FOKINA, A. F., Moscow Institute of Steel and Alloys

[Russian abstract provided by the source]

[Text] A study is made of conditions for combination pulverization of granules and chips of R18 high-speed steel into powder in rotating ball mills with titanium carbonitride additives, and the subsequent processes involved in converting the powder composition to compact workpieces. It is shown that the titanium carbonitride additives have an intensifying effect on the process of pulverization of the sputtered granules and chips. When sintering is done in acutely dried hydrogen without formation of a liquid phase at 1200-1250°C for 60 minutes, sintered workpieces are made with a relative density of more than 95% with titanium carbonitride content of 0-10 vol.%. Adding titanium carbonitride increases the hardness of the high-speed steel from 59 to 68 HRC (10 vol.%) and gives an average carbide

grain size of 1.0-2.0 μm with uniform distribution in the martensite base. An investigation is made of preliminary schedules for forging and heat treatment of sintered high-speed steel specimens doped with titanium carbonitride. Figures 3; references 9: 8 Russian, 1 Western.

USSR

UDC 669.14.018.75:621.78.062

INTERACTION OF TYPE Kh13Yu HEAT RESISTANT STEEL WITH WATER VAPOR

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1, Jan-Feb 77 pp 115-116 manuscript received 17 Dec 75

ZVESDIN, YU. I., MAKARENKO, V. G. and POVYSHEV, I. A.

[Abstract] A study was made of the composition, structure and properties of the oxide films formed on type Kh13Yu chrome-aluminum steel with varying content of carbon as it interacts with superheated steam. Oxidation of specimens of the steel studied was performed in the 500-900 C temperature interval at a steam pressure of 0.8-1.0 atm. gauge for 20 hours. Metallographic analysis of the oxide film indicated a three-layer structure of the steels, its total thickness increasing with increasing temperature. Even when a multilayer oxide film is formed on the metal, the rate of gas corrosion in steam in the final analysis is limited not by the rate of the reaction of oxidation of the surface layer, but rather by the rate of diffusion of oxygen through the compact fine crystalline pseudoamorphous oxide layer. Analysis shows that the inner layer of the scale is rich in chromium and aluminum, while the outer layer contains practically none of these elements, which are replaced by oxides of iron. In spite of the high concentration of defects in the surface layer of scale, rich in iron-based oxides, type Kh13Yu steel with carbon content 0.01-0.12% shows great heat resistance in water vapor at temperatures up to 750-800 C. The thermodynamic stability of the inner layer of the oxide film, consisting of primarily of oxides of chromium and aluminum as well as complex spinel-structure oxides, goes far toward determining the effectiveness of the protective coating.

Superhard Materials

USSR

UDC 621.9.025.7:661.65

HEXANITE-R AND HEXANITE-A -- NEW TOOL MATERIALS

Moscow STANKI I INSTRUMENT in Russian No 2, Feb 77 pp 6-7

KARYUK, G. G., BOCHKO, A. V., and BARABAN, V. P.

[Abstract] Polycrystal superhard materials based on wurtzite-like boron nitride have been developed at the Institute of Problems of Material Science, Academy of Sciences UkrSSR. The materials are called hexanite-R and hexanite-A and are used for making cutting and grinding tools respectively. The materials are produced in the form of polycrystals of up to 6 mm in diameter. Presently, a process of producing crystals of up to 7-8 mm is being developed. The crystals have a hardness of 4,000-7,000 kgs/mm² on the Vickers scale, and a high heat-resistance of 800-900°C. The article presents cutting conditions in machining of hardened steels, hard alloys and cast iron with cutting tools made of hexanite-R. Also given are figures on the properties of grinding discs made of hexanite-A bonded with either metallic or organic bonds.

USSR

UDC 666.233

METHOD OF SYNTHESIZING SUPERHARD MATERIALS BY EXPLOSION

Kiev SINTETICHESKIYE ALMAZY in Russian No 5, 1976 pp 21-26

LUKASH, V. A., Institute of Superhard Materials, Academy of Sciences Ukrainian SSR, PETUSHKOV, V. G., Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR, DIDYK, R. P., Dnepropetrovsk Mining Institute imeni Artem and MARTSENKEVICH, G. I., Institute of Mining imeni A. A. Skochinskiy, Academy of Sciences USSR

[Abstract] The authors are concerned with a study of methods for synthesizing superhard materials involving the use of shock waves which create high pressures and the concomitant high temperatures which are necessary for the synthesis of superhard materials. They discuss three methods of creating the necessary conditions; the first of these is the two-dimensional variation in which a plate is used to conduct the shock wave to the material to be treated. The cylindrical variation employs various cylindrical ampules, the most widely used today being the hollow and coaxial ones utilized in the synthesis of diamonds. The third method used by the authors is that of cumulative loading; the cumulative stream pressure discussed here is defined as the pressure on the interface of two media at the moment of impact. The authors' investigations permitted comparisons to be made of the various schemes for creating high pressures and temperatures by use of the explosive energy. Figures 4; references 8: 5 Russian, 3 Western.

Thermomechanical Treatment

USSR

UDC 539.4.014.2

THERMOMECHANICAL TREATMENT OF TRANSITION CLASS STAINLESS STEEL WITH
Kh15N5AM3 MARTENSITE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 143-144 manuscript received 13 Nov 75

DORONIN, I. V., Moscow

[Abstract] A study is made of the hardening of Kh15N5AM3 steel ($C = 0.15\%$, $Cr = 15.0\%$, $Ni = 4.75\%$, $Mo = 2.40\%$, $N = 0.05\%$) by means of low-temperature thermomechanical treatment with hot deformation of the martensite according to the following plan: heat treatment to martensite with subsequent deformation of the martensite at $20-650^\circ C$ and cooling in air. The deformation was performed by rolling on a laboratory DUO-200 mill at $V = 2.6 \text{ sec}^{-1}$ and by stretching of specimens at $V = 0.03 \text{ sec}^{-1}$. The optimal combination of strength and ductility was achieved by deformation at $450-480^\circ C$ to $\epsilon = 5-15\%$. In this case, ductility is retained rather high, almost the same as after the standard heat treatment. Hot deformation helps to break up and fragment the crystals of martensite, which is confirmed by the results of electron microscope transmission studies. Secondary phases, including carbide phases, are absent and at the same time effective blocking of dislocations by atoms of the alloying elements is achieved. References 2: both Russian.

Thin Films

USSR

UDC 539.23

FORMATION OF THIN FILMS UNDER THE INFLUENCE OF ELECTRON BOMBARDMENT

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 72-74 manuscript received 28 Apr 76

ARANOVICH, G. L. and VISHNYAKOV, B. A., Moscow

[Abstract] A model is suggested for the growth of inorganic films produced under the nonthermal influence of electrons on adsorbed molecules of a decomposed compound. The model suggested agrees well with experimental results involving heteroorganic compounds. It is established that the transition from a defocused beam to a sharply focused beam, with unchanged process parameters, does not change the rate of the process of film growth. This is explained by the fact that in the stable mode, the thickness of the adsorbed layer decreases with increasing beam current density in such a way that the excess of electrons does not lead to an increase in ω .
Figure 1; references 8: 6 Russian and 2 Western.

Titanium

USSR

UDC 669.295.017:539.3/5

THE FAVORABLE INFLUENCE OF HYDROGEN ON THE DUCTILITY OF β TITANIUM ALLOYS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 3-7 manuscript received 18 Feb 76

MAL'KOV, A. V. and KOLACHEV, B. A., Moscow Institute of Aviation Technology

[Abstract] This work presents a study of the influence of hydrogen on the ductility characteristics of the β titanium alloy VT30 in the hardened (β structure) state; the chemical composition of the alloy is 10.4% Mo, 6.18% Zr, 4.33% Sn, 0.14% Fe, 0.1% O, 0.026% N, 0.04% C. Specimens were quenched in water after heating to 820°C. The hydrogen was introduced by thermal diffusion; the hydrogen content was tested on a spectrograph. Two interesting peculiarities were noted: 1) beginning at a certain hydrogen concentration, the ratio of tensile strength to yield point decreases; and 2) at low concentration (within the limits of the technical conditions for hydrogen content in titanium alloys) the hydrogen reduces necking down of β alloys, then as its concentration is increased (to several times that called for by the technical conditions) it greatly increases necking down. This effect is found to be quite sensitive to deformation rate. As deformation rate increases, the tendency toward an increase in the "dip" in the ductility curve in the area of low hydrogen content and toward slower recovery of ductile properties with increasing hydrogen content is noted. Figures 5; references 10: 9 Russian, 1 Western.

USSR

UDC 669.295:620.171+532.6;539.375

INFLUENCE OF CERTAIN MEDIA ON THE HIGH-TEMPERATURE DUCTILITY OF TITANIUM

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 114-115 manuscript received 15 May 75

DIVISENKO, I. F. and KORENYUK, YU. M.

[Abstract] Type VT1-0 technical titanium was tensile tested in the 700-1000°C temperature interval in air, in a vacuum and in melts of aluminum and its alloy with 6 wt. % magnesium. Technical titanium when stretched in air shows increased ductility in the 900°C temperature interval, when polymorphous conversion of the material occurs. When titanium is deformed in aluminum melts, the interval of increased ductility is shifted toward lower temperatures. The same effect has been noted for pure titanium. Aluminum acts as a deoxidizer for titanium. In the aluminum-magnesium melt, the temperature interval of increased ductility of the material is

significantly expanded in comparison to tensile testing in air, the plastic properties produced approaching the characteristics of titanium in a vacuum. Thus, the studies showed that the plasticizing effect of liquid aluminum and its alloy with 6 wt. % magnesium is manifested in the temperature interval below 900°C. As temperature is increased further, the ductility of titanium in contact with liquid metals decreases, becoming practically the same as the ductility of titanium in air. References 2: both Russian.

USSR

UDC 669.018:620.66.0694

HIGH-TEMPERATURE OXIDATION OF TiB_2-TiSi_2 ALLOYS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2 (170), Feb 77 pp 34-37
manuscript received 28 Oct 74

PUGACH, E. A., GOLOVKO, E. I. and DVORINA, L. V., Institute of Problems of Material Science, Academy of Sciences UkrSSR

[Abstract] A study is made of the oxidation of the alloy TiB_2-TiSi_2 at intervals of 20 mol. % ($80TiSi_2+20TiB_2$, $40TiSi_2+60TiB_2$, $20TiSi_2+80TiB_2$) in air at 1000 and 1200°C for 7 hours. According to metallographic studies, the structure of the initial alloys has two phases. The melts contain immiscible phases TiB_2 ($H_u = 3400 \text{ kg/mm}^2$) and $TiSi_2$ ($H_u = 1100 \text{ kg/mm}^2$). Metallographic and x-ray studies of the oxidized specimens indicate that the alloys are more resistant to oxidation than pure TiB_2 or $TiSi_2$. The high protective properties of boric anhydride and silica, as well as the peculiarities of their formation, facilitate the formation in the scale of the alloys of silicon monoxide, titanium nitride and silicon nitride. Figures 3; references 11: 8 Russian, 3 Western.

USSR

UDC 669.295.7

INFLUENCE OF INHIBITORS ON THE CORROSION OF TITANIUM ALLOYS IN CHLORIDE SOLUTIONS OF TITANIUM-MAGNESIUM PRODUCTION

Moscow TSVETNYYE METALLY in Russian No 1, Jan 77 pp 60-61

DOBRUNOV, YU. V., VOLYNSKIY, V. V., KOLOBOV, G. A. and KUZNETSOV, S. I.

[Abstract] Corrosion tests are done by a weight loss method under laboratory conditions to find suitable titanium alloys for use as structural materials

in equipment for circulation purification of gases in titanium-magnesium production. The results show that VT1-0, OT4 and VT5-1 alloys have high resistance to corrosion in 10% and 18% HCl containing 5 and 10% carnallite in the presence of 0.1-1% FeCl_3 or HNO_3 . Grade 4200 alloy is resistant in hydrochloric acid solutions in the presence of carnallite up to 80°C. Kh18N10T stainless steel shows poor corrosion resistance in all media studied.

USSR

UDC 669.295'293:621.785.3

INFLUENCE OF THE KIND OF DEFORMATION ON THE DISSOCIATION OF α'' -MARTENSITE IN VT16 ALLOY

Moscow TSVETNYYE METALLY in Russian No 1, Jan 77 pp 68-70

MAL'TSEV, M. V.

[Abstract] An investigation is made of the influence of the kind of deformation on phase transformations in VT16 alloy quenched from 800°C to a structure consisting chiefly of α'' -martensite and a small amount of α - and β -phases. Phase transformations were studied radiographically on the URS-50IM diffractometer. The results show that during deformation the transformation of α'' -martensite leads to the formation of β -phase, and under the influence of the stress field the lattice of this phase is distorted, becoming very slightly tetragonal, the ratio of lattice parameters c/a being less than unity in the case of upsetting, and greater than unity in the case of stretching. The critical fracture stress under stretching deformation is reached at higher degrees of deformation than is the case for upsetting. This explains why VT16 alloy is less ductile in the upsetting process than when it is stretched. With an increase in the degree of deformation there is a gradual transition from rhombic to hexagonal structure, i.e., from the α'' - to the α' -phase. The ratio of the lattice parameters of the α'' -martensite determines the degree of conversion to the α' -phase, which in turn determines the ductility during deformation. For the same degree of deformation, parameter a is smaller and parameter b is larger for upsetting than for stretching, which agrees with ductility data. Figures 2.

USSR

UDC 669.873.018

INFLUENCE OF HOT DEFORMATION CONDITIONS ON THE FORMATION OF THE STRUCTURE
OF VT22 ALLOY

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 6,
Dec 76 pp 1257-1265 manuscript received 1 Apr 76

NOTKIN, A. B., GEL'MAN, A. A., PERTSOVSKIY, N. Z., SEMENOVA, N. M., and
GOLUBEVA, G. V., All-Union Institute of Light Alloys

[Abstract] The authors study the structure of VT22 alloy after various conditions of hot deformation and subsequent heat treatment to find the structure that gives the optimum set of strength and ductility characteristics in the heat-hardened state. Hot deformation was done by pressing on workpieces heated to 850-1200°C at a strain rate of 0.5-4 mm/s for isothermal conditions, and at 70 mm/s for ordinary conditions. The structure and mechanical properties of the specimens were studied in the hot-pressed and heat-treated states (quenching from 750°C with holding for one hour and cooling in water followed by aging at 540°C for 8 hours). Optical and electron microscopes were used. The structures observed in semifinished VT22 alloy workpieces with variation of the main pressing parameters are determined by the degree of development of processes of recrystallization in the β -region, and differ from one another in the proportions between recrystallized, unrecrystallized and polygonized sections. The best combination of strength and ductility characteristics in the heat-hardened state is shown by a polygonized structure with subgrain size of less than 10 μm and azimuthal disorientation of 2-5°. The completely recrystallized structure formed in the process of hot deformation results in a low level of ductility in the heat-hardened state. The instability of mechanical properties of VT22 alloy can be attributed to the nonuniformity of the structure produced by hot deformation. The ductility in the heat-hardened state decreases in cases where deformation is accompanied by conditions for development of intense recrystallization, and recrystallized sections become predominant in the structure. Figures 4; references 6: 5 Russian, 1 Western.

THE PUBLICATIONS THAT CONCERN THE FORMATION OF METALLIC PHASES

USSR

UDC 669.017

ON THE PRINCIPLES THAT GOVERN THE FORMATION OF METASTABLE PHASES IN
TITANIUM ALLOYS

Ordzhonikidze IVUZ, TSVETNYYE METALLY in Russian No 6, 1976 pp 85-89
manuscript received 24 Oct 75

KOLACHEV, B. A., LYASOTSKAYA, V. S. and SHISHKUNOVA, N. V., Moscow Institute
of Aviation Technology

[Abstract] The mechanism of formation of metastable phases is investigated on the basis of an analysis of published data relating to the fixation of β - and ω -phases as titanium alloys are quenched. Two criteria of formation of metastable phases were assumed: the second critical concentration C_{cr}'' at which the martensite phase disappears in the structure of the quenched alloys, and the third critical concentration C_{cr}''' at which the β -phase replaces the structure represented by the β - and ω -phases. The results of the analysis are given in the form of a table that summarizes conditions of fixation of metastable phases during quenching of titanium alloys. It is found that the critical concentrations correspond to a fairly broad range of electron concentrations: 4.12-4.40 and 4.15-4.45 el/at respectively for C_{cr}'' and C_{cr}''' . It is shown that an increase in the number of electrons taking part in the formation of d-electron configurations at the expense of a reduction in the number of electrons that form the p-configuration should improve stabilization of bcc structures. A table is given comparing the theoretical and experimental critical concentrations at a temperature of 900°K for titanium alloyed with elements of groups VB, VIB, VIIIB and VIII. The satisfactory agreement observed indicates that thermodynamic analysis gives a usable representation of the critical concentrations. The most important parameter in the formula used to calculate the critical concentrations is the concentration of alloying element in the β -phase. Therefore the conditions of stabilization of the β -phase under equilibrium conditions have a decisive effect on the conditions of fixation of the β -phase during quenching, although the relation between them is nonlinear.

References 23: 20 Russian, 3 Western.

Transformation and Structure

USSR

UDC 669.141.24.017

INFLUENCE OF QUENCHING TEMPERATURE ON THE KINETICS OF STRUCTURAL TRANSFORMATIONS AND THE MECHANICAL PROPERTIES OF CARBON STEELS

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 2, 1977 pp 119-122
manuscript received 18 Sep 75

KOROTUSHENKO, G. V., VASHCHENKO, I. P. and KUZNETSOVA, L. M., Murmansk Higher Engineering Naval Academy

[Abstract] The authors used industrial carbon steels to study the kinetics of structural transformations, the composition and structure of the alpha-phase which form in the process of heat treatment and high-temperature mechanical treatment including the quenching element from temperatures above 1200°C. They also studied the mechanical properties of type 45 steel in various structural states. The authors fixed the structure of massive martensite with carbon concentrations up to 0.6-0.65% in the process of quenching from 1200°C. With carbon concentrations from 0.7 to 1.17%, a mixed structure appears in the process of quenching from 1200°C in water, which consists of massive and twinned martensite. Here the amount of twinned martensite is maximum at 1.17% carbon. The temperature of the onset of formation of the massive martensite is found to be above the martensite point and coincides with the temperature of the onset of the bainite transformation in the corresponding industrial carbon steels. Treatment on the structure of highly annealed bainite massive martensite permits achieving a higher level of structural strength, especially if the treatment guarantees that a scale of 5-6 grain size will be obtained under the conditions that exclude the appearance of 300-degree brittleness. Figures 4; references 5: 4 Russian, 1 Western.

Welding

USSR

UDC 621.791.762.1

TEMPERATURE AND STRAIN DISTRIBUTION WHEN URANIUM RODS ARE RESISTANCE BUTT-WELDED TO TITANIUM

Kiev AVTOMATICHESKAYA SVARKA in Russian No 1(286), Jan 77 pp 19-21 manuscript received 1 Jun 76

TATARINOV, V. R., engineer, KRASNORUTSKIY, V. S., candidate of physical and mathematical sciences, Khar'kov

[Russian abstract provided by the source]

[Text] The paper describes the results of investigations of temperature-time and strain characteristics of the process of resistance welding of circular uranium and titanium rods 6-7 mm in diameter. It is shown that in the initial welding period (about 2/3 of the welding time) the maximum temperature and strain are shifted toward the titanium side, while in the concluding period the deformation of uranium reaches the level of maximum transverse deformation of titanium. On surfaces where the minimum deformation [degree of increase in the contact area of the metals being joined] is equal to 1.5-3, the removal of oxides and contaminants from the weld is inadequate, which results in lower welding quality. Figures 2; references 4: all Russian.

USSR

UDC 621.791.753.9

EFFECTIVE ARC IONIZATION POTENTIAL IN FLUX WELDING OF TITANIUM

Kiev AVTOMATICHESKAYA SVARKA in Russian No 1(286), Jan 77 pp 13-15 manuscript received 13 Sep 76

ZAMKOV, V. N., candidate of technical sciences, PRILUTSKIY, V. P., engineer, and GUREVICH, S. M., doctor of technical sciences, Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences UkrSSR

[Abstract] An investigation is made of the influence of easily ionizable flux components on the effective ionization potential of the arc column in titanium welding. The amount of the products of dissociation of flux vapor in the arc was determined with consideration of the equilibrium constants calculated for reactions of the type $\text{MeF} \rightarrow \text{Me} + \text{F}$. It was found that the effective ionization potential at all temperatures is greatest when welding is done without flux, and is the least when welding is done with CsCl flux. The effective ionization potentials are intermediate between the extreme values when other alkali halides -- LiF, NaF, KF, CsF -- are introduced into the welding arc. Whether welding with or without flux, the

effective ionization potential is determined by the ionization potential of the shielding gas and titanium vapor. Figures 3; references 8: 7 Russian, 1 Czech.

USSR

UDC 621.791.011

WELDABILITY OF THE ALUMINUM CASTING ALLOYS AL2, V124 AND VALG

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 77 pp 66-67

IGNAT'YEV, V. G., RABKIN, D. M., ANTONENKO, L. N., REZNICHENKO, V. F. and MILITSIN, K. N.

[Abstract] In order to study and produce a comparative evaluation of the characteristics of weldability and other properties of the joints in the alloys VALG, V124 and AL2, plates 270 x 140 x 7 mm were chill molded, milled on both sides to a thickness of 4.5 mm, then used to produce "fish skeleton" specimens. The results of the study showed that, in contrast to deformable aluminum alloys, the metal of the welded joints in the casting alloys in question is not only not inferior in strength and density, but is actually superior to the base metal. One exception is to be found in parts produced by casting under pressure, welding of which causes intensive formation of pores in the seam metal and zone of melting. To produce joints without pores, parts of welded and cast products must be molded under pressure with evacuation of the press mold. Figures 2; references 4: 3 Russian, 1 Western.

USSR

UDC 621.791.01:620.192.46

THE INCREASE IN TECHNOLOGICAL STRENGTH OF SEAM METAL IN EI943 STEEL WELDED UNDER CERAMIC FLUX

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 77 p 65

ABRALOV, M. A., SERGEYEV, V. G. and YAKUSHIN, B. F.

[Abstract] This work, performed at Tashkent Polytechnical Institute and Moscow Higher Technical School, presents the results of a study of the influence of zirconium, cerium and yttrium on the tendency of seam metal in welded seams of EI943 steel toward the formation of hot cracks. All of the rareearth elements listed have great affinity for oxygen. Therefore, to assure the greatest transfer factor of the REM from flux to melted metal,

welding was performed beneath a neutral flux based on fluorspar and stable oxides of aluminum, barium and zirconium (the latter two in the form of spinel), cerium and yttrium were introduced to the flux separately in master alloys, as well as jointly as a combined master alloy; zirconium was added as a metal powder. It was found that seams made under flux with the combined master alloy had the best technological strength, followed by seams made in the metal using flux with separate master alloys containing cerium and yttrium and, finally, seams made under flux with metallic zirconium powder added. Figures 1; references 3: all Russian.

USSR

UDC 621.791.052.011:539.3

CORNER DEFORMATIONS UPON LASER WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 77 pp 49-50 manuscript received 22 Jul 76

KUDRINSKIY, K. A., GOL'TSOVA, V. P. and ZAV'YALOV, N. A., Engineers, Voronezh

[Abstract] The purpose of this work was to estimate the deformation of specimens during pulse laser welding without pressing of the specimens against the equipment. The radiation energy and number of welded points were varied. The experiments were performed both on materials whose structure does not change under the influence of laser radiation, such as 12Kh18N10T steel, and on materials with a clear conversion structure in the zone of the thermal effect (type 10 steel). It was found that when specimens were welded with a gap at the butt (up to 0.1 mm), welding deformations were sharply decreased. The presence of the gap is equivalent to the appearance of a zone with a high absorption factor at the heating spot, leading to advancing melting of the edges of the joint and intensive formation of a crater and, in the final analysis, to displacement of the center of the melted bath toward the center of the thickness of the metal. Laser pulse welding of unrestrained miniaturized parts of steels of both types caused deformation of the parts welded, although as the number of welded spots was increased in 12Kh18N10T steel, the angular deformations increase, reaching about 2°, while for type 10 steel the degree of deformation is determined by the first welded spot, reaching about 1°. Figures 2; references 3: all Russian.

USSR

UDC 621.791.85

ELECTRONIC-OPTICAL MODEL OF THE MELTING CHANNEL IN CATHODE-RAY WELDING
AND PROCESSING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 43-48 manuscript received 25 Aug 76

NOVIKOV, A. A., Vinnitsa

[Abstract] The parameters of the plasma in a melting channel are estimated on the basis of a partial analogy of processes in the channel and discharges with evaporating electrodes. The dependences of critical aperture angle of penetrating melting on parameters of the electron beam and plasma are presented. It is shown that the focusing of fast electrons in the beam in the channel is determined by their reflection from the walls in the double space charge layer. The channeling condition depends on the angle of convergence and the velocity of the electrons, the form of the channel, the plasma potential and the scattering angles. Known technological effects of cathode-ray processing are analyzed on the basis of analysis of the relationship produced. Parameters estimated include the structure and oscillations of the plasma, distribution and gradient of potentials, current, balance of energy and charged particles, etc. and their influence on the conditions of propagation of the electron beam and technology of welding. The diffusion nature of the processes in the plasma in the melting channel indicates that they are more stable for broad and powerful electron beams in channels in which the vapor dynamic and hydrodynamic instabilities of the liquid walls are stabilized. The determining factors in penetrating melting are the processes of elastic reflection of electrons from the walls of the channel, processes of electron scattering on ions and high-frequency plasma fluctuations, the angle of convergence of the beam, and its accelerating and focusing voltage. Figures 1; references 17: all Russian.

USSR

UDC 621.791.01:620.192.46

HIGH-TEMPERATURE DEFORMATION AND FORMATION OF CRACKS NEAR SEAMS DURING
WELDING OF NIMONIC ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 11(284), Nov 76 pp 40-44
manuscript received 15 Apr 76

EYDEL'SHTEYN, V. YE., VAKUSHIN, B. F., Moscow Higher Technical School imeni N. E. Bauman, and STOLBOV, V. I., Tol'yatti Polytechnical Institute

[Abstract] It is shown that the formation of hot cracks near the seam during welding of heat-resistant nickel alloy over 3-4 mm thick results from high

temperature extension of the metal in the direction of its thickness. The period of maximum rate of internal deformations is established, and found to agree with the temperature interval of brittleness of the alloy. The influence of technology and mode of welding on high temperature deformation and hot crack formation tendency in the seam zone is analyzed. It is the orientation of the maximum tensile stress in the direction of thickness of the elements joined which explains the unique orientation of hot cracks perpendicular to the thickness of the sheet in the zone around the seam. The internal tensile deformations through the thickness of the metal reach their maximum rate in the interval between the maxima on the curves of thermal and deformation cycles corresponding to the brittleness temperature interval. Acceleration of butt welding increases the rise rate of internal deformations across the thickness and increases the tendency to the formation of cracks near the seams. Figures 6; references 13: all Russian.

Miscellaneous

USSR

UDC 669.715:620.1

A NOMOGRAM FOR DETERMINING THE SOLUBILITY OF HYDROGEN IN ALUMINUM AND ITS ALLOYS

Moscow TSVETNYYE METALLY in Russian No 12, Dec 76 pp 54-56

KOROTKOV, V. G.

[Abstract] A nomogram is given for predicting the solubility of hydrogen in aluminum and its alloys. This graphic computational aid is based on thermodynamic data for the simplest alloy-forming systems and account for the mechanism of interaction and one of the main sources of hydrogen saturation of aluminum alloys--atmospheric moisture--which can be absorbed on the charge materials, furnace walls, tools and so forth. The proposed nomogram can be used for pure aluminum and for alloys of Al + 5% Mg, Al + 4.5% Cu, Al + 7% Si and Al + 11.5% Si. References 3: all Russian.

USSR

UDC 669.245

INFLUENCE OF EXTERNAL LOADING ON THE KINETICS OF AGING AND THE PRINCIPLES THAT GOVERN THE SPATIAL DISTRIBUTION OF PARTICLES OF γ' -PHASE IN NICKEL ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDNEIYE in Russian Vol 42, No 6, Dec 76 pp 1294-1300 manuscript received 15 Mar 76

TYAPKIN, YU. D., TRAVINA, N. T., KOZLOV, V. P. and UGAROVA, YE. V., Institute of Metallography and Physics of Metals, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Russian abstract provided by the source]

[Text] An investigation is made of Ni-Al-Cr and Ni-Al-Ti alloys with different self-fields of elastic distortions that arise as a consequence of coherent union of γ - and γ' -phases. It is found that the morphology and nature of spatial distribution of particles of γ' -phase behave differently depending on the sign of the applied external loads (tensile or compressive) and also on the magnitude of self-fields of elastic distortions. A higher degree of order is observed in the distribution of particles in Ni-Al-Ti alloy in which the magnitude of self-fields of elastic distortions is considerable. Figures 3; references 10: 5 Russian, 5 Western.

USSR

UDC 539.217.3:669.245

USING AUTORADIOGRAPHY TO STUDY STRUCTURAL DEFECTS IN EUTECTIC ALLOYS BASED ON COBALT WITH CARBIDE HARDENING

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 6, Dec 76
pp 1221-1228 manuscript received 30 Mar 76

BOKSHTEYN, S. Z., ZYULINA, N. P. and MIRSKIY, L. M., All-Union Scientific Research Institute of Aluminum and Magnesium, Moscow

[Russian abstract provided by the source]

[Text] A high-resolution autoradiography technique is used to reveal and investigate structural defects in eutectic alloys (Cr, Cr, Ni)-TaC and (Co, Cr)-(Cr, Co)₇C₃ melted by the method of directional crystallization. A comparative analysis is done on experimental data relating to specimens with different degrees of perfection of the structure. It is shown that the boundaries of dendrites, grains and colonies are highly permeable by diffusion, and that there is no preferred impurity enrichment of interphase boundaries between the carbide and the matrix of regular structure in eutectic cobalt alloys. Figures 5; references 6: 3 Russian, 3 Western.

USSR

UDC 535.211

THE KINETICS OF MELTING OF STEEL BY A LASER BEAM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 135-137 manuscript received 10 Mar 74

BALATSKIY, A. A., UGLOV, A. A. and LOBACHEVA, G. YA., Moscow, Saratov

[Abstract] Experimental data are presented from high-speed photography in the time loop mode of the zone of action of pulsed laser radiation. A study is made of the features of motion and ejection of the liquid phase as a radiation pulse is interrupted by means of a spinning disc with apertures, as well as with a continuous pulse. The melting of the liquid phase with flux densities of about 10^5 W/cm² occurs with a change in the level of the surface of the melt and, consequently, with a change in radiation flux density. The melting process is accompanied by the formation of a certain volume of liquid phase on the surface of the bath, which is mixed by the action of recoil pressure at the edge of the bath. The motion of the liquid phase is turbulent, particularly when the laser beam is interrupted by the spinning disc. References 5: all Russian.

USSR

UDC 539.16.04:669.017

EFFECT OF LASER RADIATION ON NITRIDES OF TRANSITION METALS IN GROUPS IV-V

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 100-106 manuscript received 6 Jul 76

SAMSONOV, G. V. (deceased), VERKHOTUROV, A. D., ROSHCHINA, A. I. and
SHVEDOVA, L. K., Kiev

[Abstract] Results are presented from studies of the erosion resistance of nitrides of metals in groups IV-V under the influence of laser radiation. The nature of change of the erosion resistance of nitrides as a function of porosity, grain size and nitrogen content is established. It is shown that the greatest erosion resistance is that of nitrides of hafnium and niobium. The erosion resistance is determined by the total contribution of Me-Me and Me-N interactions to the total interatomic nitride bond. The erosion resistance upon laser processing decreases with increasing material porosity, a result of the better conditions of formation and elimination of the liquid phase upon processing. Figures 4; references 14: 13 Russian, 1 Western.

USSR

UDC 669.04

MICROMETALLURGY AND PROSPECTS FOR ITS DEVELOPMENT (A REVIEW)

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 53-66 manuscript received 14 Jun 76

POSTNIKOV, V. S., Voronezh

[Abstract] A literature review is presented of the current state of the problem of micrometallurgy -- areas of application (particularly microelectronics), methods and results produced and prospects for development. In addition to the achievements of micrometallurgy, significant attention is given to problems which will be important for microelectronics and materials science in the future, but as yet are unsolved. Areas covered include gas phase precipitation, liquid phase precipitation, gas-liquid phase precipitation, growth mechanisms and kinetics, modeling of structures and biochemical micrometallurgy, in which various types of microbes and fungi are used for the extraction of metallic elements such as copper, gold, silver, iron, manganese, vanadium, thorium, uranium, etc. from lean ores, production wastes, sea water, etc. In the future, microorganisms may be used for the growth of microcrystals, buildup of layers and healing of microdefects in parts and structures; they may also be used to grow and join elements of microcircuits according to predefined programs. References 43: 39 Russian and 4 Western.

USSR

UDC 621.791.75.001:537.523

THE MECHANISM OF PLASMA ATOMIZATION OF WIRE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 14-16 manuscript received 7 Jan 76

PETRUNICHEV, V. A. and TITKOV, V. V., Moscow

[Abstract] An experimental study is presented of the mechanism of plasma atomization of a wire. High speed photography and cinematography reveal the transient characteristics of the liquid metal drops formed at the end of the wire for variable technological parameters of the process. On the example of addition of oxygen to the plasma as a surfactant, the possibility is demonstrated of increasing the yield of the fine fraction of the product produced. The plasma process of atomization of wire is characterized by a change in the form of transition of the liquid metal with increasing thermal power and gas dynamic head of the jet from the drop to the jet state and significant intensification of the process in the presence of surface-active oxygen. Figures 1; references 5: all Russian.

USSR

UDC 536.3

CALCULATION OF THE TIME OF CLOSURE OF A THIN CYLINDRICAL APERTURE IN A FLUID

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 77
pp 3-9 manuscript received 19 Apr 76

RYKALIN, N. N., UGLOV, A. A., ZUYEV, I. V., IVANOV, V. V. and KOREN'KOV,
V. I.

[Abstract] A study is made of the problem of determining the time of closure of a narrow cylindrical channel formed by the action of a highly concentrated flux of energy (electron beam, laser beam, etc.) on a condensed phase. It is assumed that the walls of the channel are formed of the liquid phase, for example a melt, and maintained in dynamic equilibrium by the vapor pressure produced by evaporation of the material from the bottom and walls of the channel. Analysis begins at the moment of interruption of the action of radiation or reduction of the flux density below a certain critical value, so that the vapor phase leaves the channel in a time which is short in comparison to the time of characteristics thermal processes in the condensed phase. It is demonstrated that failure to consider the viscosity involved in the motion of the liquid phase filling the channel produces artificially low closures times, by 1 or 2 orders of magnitude. Failure to consider capillary and gravitational forces has a smaller influence on the accuracy of the model of motion of the liquid (difference within the limits of 1 order of magnitude) than failure to consider viscosity of the liquid. References 3: all Russian.

USSR

UDC 541.183:678.744.335+678.019.31

THE INFLUENCE OF THE ADSORPTION FACTOR ON THE DISPERSING CAPACITY OF
POLYMETHYLMETHACRYLATE

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 13, No 1,
Jan-Feb 77 pp 89-92 manuscript received 7 May 75

GOROKHOVSKIY, G. A., SAMSONOV, G. V. (deceased) and GORSHUNOV, V. P.,
Institute of Chemistry of High Molecular Compounds, Academy of Sciences
UkSSR, Kiev

[Abstract] This study deals with the determination of the interrelationship between the rate of adsorption of polymer macromolecules on certain refractory compounds and the dispersing capacity of polymer abrasive compositions. For each concentration of polymer tested, the kinetics of adsorption of PMMA were represented as a curve. Adsorption was tested at a constant temperature of 24°C; the dispersing capacity of the compositions was estimated on the basis of the wear of a steel specimen in contact with a tool of $1 \text{ kg} \cdot \text{cm}^{-2}$. The results of the study and experiments indicate that the dispersing capacity of polymer abrasive compositions is determined not only by the cutting properties of the abrasives and dispersing capacity of the polymers, but also by the absorption properties of the solid phase, its capacity to transport macromolecules to the surface being worked. Figures 2; references 4: all Russian.

USSR

UDC 669.27:620.1

DEFORMATION RESISTANCE AND HARDENING FACTORS OF LOW-ALLOY TUNGSTEN

Moscow TSVETNYYE METALLY in Russian No 2, Feb 77 pp 55-57

BERMAN, S. I., CHERNYSHEV, V. N., ZOLOTOV, V. S., KARTSEV, V. D. and
YUDKOVSKIY, S. I.

[Abstract] Calculation of the forces of deformation of metals based on formulas known from the theory of pressure working requires that we know the deformation resistance of the metal under static and dynamic linear loading, or one of these characteristics and the hardening factor. This work presents an attempt to determine the dynamic deformation resistance and hardening factor of tungsten alloys in the interval of deformation temperatures. A casting alloy based on VV2 tungsten was deformed and heat treated by recrystallization. The resistance of the metal to deformation under static linear loading was determined in extension on 3-mm-diameter specimens in the 1300-2000°C interval. The value of the tensile strength

of the material was taken as the static deformation resistance. As the deformation rate was increased from 1 to 20 s^{-1} , the hardening factor varied by about 20%, an increase in rate corresponding to a decrease in hardening factor rise rate. Therefore, the factors produced can be used for calculations over a broad range of deformation rates (from 1 to 100 s^{-1}). Figures 5; references 6: all Russian.

USSR

UDC 621.791.92.04

HIGH-TEMPERATURE NICKEL ALLOYS FOR SURFACING ENGINE VANES

Kiev AVTOMATICHESKAYA SVARKA in Russian No 1(286), Jan 77 pp 53-55, 67
manuscript received 30 Jul 76

PEREMILOVSKIY, I. A., engineer, Zaporozh'ye Engine Plant, and KAZANTSEVA, N. A., candidate of technical sciences, Zaporozh'ye Metallurgical Institute

[Abstract] An investigation is made of the properties of nickel alloys with carbide-forming additives (chromium, titanium, vanadium, niobium) and intermetallic strength-forming AlTi compounds. The alloys were studied for their feasibility in surfacing of gas turbine aircraft engine vanes. It was found that Kh30N50YuT alloy has the best combination of properties for surfacing (C 1.60%, Cr 34.0%, Al 5.8%, Ti 1.80%, Fe 0.50%, Si 0.50%, B 0.008%). Figures 5; references 3: all Russian.

USSR

UDC 539.4

INVESTIGATION OF CREEP IN MOLYBDENUM SINGLE CRYSTALS

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 17-20 manuscript
received 12 Mar 75

ZASIMCHUK, YE. E. and KRIVENYUK, V. V., Institute of Problems of Strength, Academy of Sciences UkrSSR, Kiev

[Abstract] A semi-empirical equation is proposed that describes creep rate as a function of time and temperature on the first and second stages of creep, based on the Bailey-Orowan concept of assuming that the increase in the density of mobile dislocations is proportional to the rate of deformation and inversely proportional to a factor that defines annihilation of dislocations (recovery). The recovery factor is assumed to depend on the

mobility of climbing dislocations. Computer calculations are shown to agree satisfactorily with experimental curves for creep of molybdenum single crystals in the temperature range of 800-1800°C and creep rates of $10^{-3} \text{--} 10^{-8} \text{ s}^{-1}$. A deviation of the experimental curves toward higher creep rates at the end of the second stage of creep is attributed to a change in the mechanism of weakening, which agrees with x-ray structural studies.

References 15: 12 Russian, 3 Western.

USSR

UDC 620.172.226

ON THE PROBLEM OF EXTRAPOLATING THE HIGH-TEMPERATURE STRENGTH CHARACTERISTICS OF METALS BY TIME-TEMPERATURE METHODS

Kiev PROBLEMY PROCHNOSTI in Russian No 1(90), Jan 77 pp 14-16 manuscript received 18 Feb 76

KOVPAK, V. I. and BAUMSHTEYN, M. V., Institute of Problems of Strength, Academy of Sciences UkrSSR Kiev

[Abstract] Despite the possibility of matching time-temperature methods with classes of materials from a given group, serious errors may result when test results are extrapolated to long periods. The authors feel that the reason for this is that conventional time-temperature methods are based on the assumption of constancy in scaling conditions of long-term strength diagrams throughout the entire time interval, although this is more frequently the exception than the rule. This paper outlines a time-temperature method proposed by V. I. Kovpak that enables one to change to new conditions of similarity that are determined in processing experimental data of limited duration, and to extrapolate to longer durations from the last condition so determined. This technique reduces the extrapolation error as compared with other methods. The procedure is based on the assumption that there are intervals of time-temperature similarity of the physicochemical and mechanical processes of development and accumulation of defects in the metal under high-temperature creep conditions. A brief comparative analysis is done on the results of extrapolating the long-term strength characteristics of metals with the various time-temperature methods and parametric techniques extensively used in engineering practice (Larson-Miller, Dorn, Manson-Sackop, Korchinskiy, Conrad, Manson-Hafford, Trunin). The analysis is based on tabulated data on long-term strength with duration of up to 10-20 thousand hours and more for pearlite, austenite and chromium steels and nickel-base alloys. The results of the study show that the method of generalized diagrams (V. I. Kovpak, M. V. Baumshteyn, A. N. Olysov, "Problemy Prochnosti," No 7, 1976) is an accurate technique for predicting long-term strength.

References 17: 10 Russian, 7 Western.

USSR

UDC 621.7.658.5.73

NEW TECHNOLOGICAL DEVELOPMENTS IN METALLURGICAL PRODUCTION OF LARGE FORGINGS

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 12, Dec 76
pp 1-4

PIMENOV, G. A., MISHULIN, A. A. and BYKOV, V. P.

[Abstract] The purpose of this research was to find new universal technological processes to produce forgings of the shaft type with regard to the physical and chemical processes that accompany plastic deformation at high temperatures with the ultimate goal of optimizing technology and improving the quality of metal forgings while simultaneously reducing the labor involved in making them. Preliminary studies showed that the conventional heating and deformation conditions used in forging support rollers of 9KhF steel from octagonal ingots with H/D = 2-2.5 and K = 5% do not always give forgings with high physical and mechanical properties. In the new technique, ingots massing 57 metric tons with H/D = 1 are heated to 1150°C, beaten with notched hammers to a given intermediate size, then reduced by upsetting to the final size. The new technique improves the quality of the forgings, improves physical and mechanical properties, cuts labor expenditures by a factor of 1.5-2 and extends the work life of support rolls for hot rolling mills by 20-25%.

References 5: all Russian.

USSR

UDC 669.018.25

INFLUENCE OF DOPING ON THE MECHANICAL AND CUTTING PROPERTIES OF THIN-SHEET INSTRUMENT STEEL

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 2, 1977 pp 98-101
manuscript received 6 Apr 76

MIGACHEV, A. P., ZUBOV, V. YA. (deceased) and GRACHEV, S. V., Ural Polytechnic Institute

[Abstract] The authors are concerned with a study of the influence of doping type 47 quenched steel with tungsten, manganese, vanadium, chromium, molybdenum and silicon on the mechanical properties and resistance to relaxation as a function of annealing temperature. The resistance to large and small plastic deformations as well as the relaxation resistance of a quenched and annealed steel are substantially increased by doping, especially with silicon, chromium, molybdenum and tungsten. Using a special device for analyzing the cutting properties of the cutting instrument the authors obtained experimental curves of the influence of doping on the cutting properties of the steel. Figures 2; references 4: all Russian.

USSR

UDC 669.112.22

DELTA-FERRITE IN MARTENSITE AGED STAINLESS STEEL EP679

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 2, 1977 pp 90-93
manuscript received 10 May 76

CHERNYAVSKAYA, S. G., KRASNIKOVA, S. I., KUZ'MENKO, S. I., DROBOT, A. V.,
LEDYANSKIY, A. F. and VUKELICH, S. B., Dnepropetrovsk State University

[Abstract] Using a large 5-ton ingot the authors investigated a delta-ferrite, its shape, amount, arrangement with respect to the dendrite structure and chemical composition. The amount of delta-ferrite in the ingot was not very high (about 1%); however its inclusions have an unfavorable technological shape since they melt in the form of a grid. The delta-ferrite differs substantially in chemical composition from the matrix in that it is rich in chromium and poor in nickel. It is quite stable and does not disappear entirely in the process of heating under deformation and during deformation. By remaining in hot-deformed products in the form of extended inclusions with sharp peaks, the delta-ferrite leads to a significant reduction in plasticity and ductility across the fiber. In fact the degree of anisotropy is 8.6. Figures 4; references 4: all Russian.

USSR

UDC 621.747.57

ON THE PROSPECTS OF USING PLASMA-ARC SURFACE CLEANING IN ROLLING PRODUCTION

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 2, 1977 pp 74-77
manuscript received 14 Jan 76

SHALIMOV, A. P. and KON'KOV, YE. A., Siberian Metallurgical Institute

[Abstract] The authors report on the results of an investigation of air-plasma cleaning of a cold highly alloyed metal. The authors used air as the plasma-forming gas based on industrial experience involving a determination of the coefficient of melting of highly alloyed steels in various plasma-forming gases and gas mixtures. They find the most promising areas of application for this method to be the cleaning of billets of highly alloyed steels which have a high degree of hardness and a large number of flaws, the cleaning of any alloyed steel if the billets have a significant degree of distortion, and also the cleaning of martensite and ferrite-martensite steels which have not been subjected to preliminary heating. Figures 3.

USSR

UDC 017:539.374

X-RAY STUDY OF AGING OF Al-Zn EUTECTOID ALLOY DOPED WITH MAGNESIUM

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 6, 1976 pp 81-84
manuscript received 7 Jul 75

FOMIN, N. YE. and MAL'TSEVA, G. K., Mordovian State University, Department of Metal Physics and Optics

[Abstract] An x-ray method was used to study aging of an Al-Zn alloy with close to eutectoid composition (80 wt.% Zn) doped with 0.1 wt.% Mg over a wide temperature range. The ingots were annealed for 170 hours, and specimens were prepared with dimensions of 3 x 12 x 15 mm. The specimens were quenched in a 10% solution of caustic soda at 15°C after holding at 375°C for two hours, and x-ray lines were recorded in an electric furnace. The intensity and half-width were determined for lines corresponding to the α' -, β - and α -phases. The lattice parameters were also determined. For 650 minutes after quenching the intensity of the lines for the α' - and β -phases at 20°C shows almost no change, then the α' intensity begins to decrease while the β intensity begins to increase, continuing for 70,000 minutes (49 days), after which the α' line disappears, while the β line continues to increase slowly. A change in slope of the curves for line intensity of these phases as a function of time shows onset of segregation of α -phase after 15,000 hours. The half-widths of the lines corresponding to these two phases remain practically unchanged, showing only a slight broadening in the case of one line corresponding to the α' -phase at the end of the stage of decomposition, due to the onset of segregation of the α -phase. The intensity and half-width of lines for the α -solid solution pass through a maximum corresponding to the disappearance of lines for the α' -phase; then they decrease to a constant value. The lattice period of the α -phase increases for a 12-month aging period, reaching the value for the stepwise annealed alloy. The lines of the α - and α' -phases are resolved, which contrasts with the case of the alloy without magnesium. The room-temperature aging characteristics are retained with aging at high temperature, but the changes occur more rapidly. Beyond 150°C the decay of the α' -phase cannot be observed at all, i.e., the reflection from the lattices of this phase disappears during heating. It is suggested that the magnesium atoms along grain boundaries retard diffusion processes, so that volumetric diffusion becomes more important. This retarding action of magnesium atoms may also be a reason for a sharp reduction in the rate of dissociation in the eutectoid Al-Zn alloy doped with magnesium. Figures 3; references 3: 1 Russian, 2 Western.

USSR

UDC 669.295

REDUCTION OF TITANIUM CONCENTRATE WITH NATURAL GAS

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 6, 1976 pp 41-44
manuscript received 5 Feb 76

MEYERSON, G. A., deceased, KIPARISOV, S. S. and YASINOVSKIY, K. D., Moscow Institute of Steel and Alloys, Department of Rare Radioactive Metals and Powder Metallurgy

[Abstract] The paper describes research on the feasibility and conditions for reduction of iron-titanium concentrate with natural gas to produce titanium hydroxycarbonitride with a predetermined oxygen-to-carbon ratio (O:C = 1:1.2-2). The chemical composition of the initial concentrate (wt.%): TiO₂--63.75, Fe₂O₃--26.40, SiO₂--1.40, Al₂O₃--1.98, CaO--0.28, MgO--0.35, Mn--0.75, V₂O₅--0.10, Cr₂O₃--0.43, miscellaneous--4.56. Average grain size was about 0.13 mm. Reduction was done in a single-zone electro-thermal fluidized bed furnace using natural gas with the following composition: N₂--1.38, CH₄--93.68, CO₂--0.38, C₂H₆--3.49, C₃H₈--1.06, C₄H₁₀--0.01%. The results of the studies showed that gas conversion by air has a favorable effect since titanium nitride is formed, and as a result the reduction temperature can be lowered. In the case of incomplete conversion, the methane in the gas phase forms thin films of pyrocarbon on the concentrate particles, which prevents caking and ensures completion of the reduction process. References 9: 8 Russian, 1 Western.

USSR

UDC 621.771.74.3

INVESTIGATION OF THE STRESSED AND STRAINED STATE OF METAL DURING BROACHING

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 1, 1977 pp 86-89 manuscript received 21 Apr 76

POTAPOV, I. N., GALKINA, N. G. and ALEKSANDROVICH, A. I., Moscow Institute of Steel and Alloys

[Russian abstract provided by the source]

[Text] A method is proposed for theoretical determination of the stressed and strained state of metal during broaching. The proposed technique also makes it possible to find the residual stresses in the metal as it leaves the region of deformation. An algorithm is compiled in accordance with the suggested scheme in ALGOL-60 for the M-220 computer. Figures 2; references 3: all Russian.

USSR

UDC 669.187

VOLTAGE CONTROL IN THE PROCESS OF ELECTROSLAG REMELTING

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 1, 1977 pp 67-71 manuscript received 3 Feb 75

VELIN, N. V. and EDEMSKIY, V. M., Syzran' Affiliate, Kuybyshev Polytechnical Institute

[Abstract] Controlling the voltage across the slag bath is one way to produce high-quality ingots by the electroslag remelting technique. Changing the voltage of the supply transformer changes the heat conditions in the remelting process, but with a delay due to thermal inertia. In this article the authors determine the coefficients of the transfer function corresponding to this voltage control process to optimize the signal for transition from one static remelting process to another predetermined set of remelting conditions. The proposed technique of forced transient conditions minimizes the time for variation of remelting conditions regardless of the technological and geometric parameters of the process. Figures 2; references 3: all Russian.

USSR

UDC 669.184.2.042.39:546.21

PREDICTING THE AMOUNT OF MOLTEN STEEL IN THE OXYGEN CONVERTER PROCESS

Moscow IVUZ, CHERNAYA METALLURGIYA in Russian No 1, 1977 pp 49-52 manuscript received 17 Feb 76

KOCHO, V. S., BOGUSHEVSKIY, V. S., SOROKIN, N. A., SOBOLEV, S. K., YASINSKIY, V. A. and BELYAYEV, YE. I., Institute of Automation

[Abstract] A mathematical description is given of optimum calculation of the metal part of the charge, programmed for the M-6000 computer. A flowchart of the algorithm is given. The proposed linear-programming algorithm was used to calculate the maximum yield of steel and the optimum amounts of scrap and lime, as well as the optimum position of the tuyere for 180 heats of the 130-ton converter at the Yenakiyevsk Steel Plant. In 10% of the cases the calculated values were lower than the actual yields, and in 6% they were too high. On the average, the amount of the heat could be increased by 2.5 metric tons each time. References 3: all Russian.

USSR

UDC 669.183.046

RATE OF DISSOLUTION OF GRAPHITE INJECTED INTO A BATH

Moscow IVUZ, CHERNAYA MELLURGIYA in Russian No 1, 1977 pp 46-49 manuscript received 12 May 76

OYKS, G. N. and SEL'TTS, K.-E., Moscow Institute of Steel and Alloys

[Abstract] In open-hearth mills where graphite is blown into the bath, the degree of utilization of graphite may be influenced by the rate of dissolution of graphite in the molten metal, which is associated with the time that the graphite particles remain in the bath. It is important that the particles remain in the molten metal long enough to be heated and completely dissolved. Since there are no direct experiments on the rate at which graphite rises to the surface in a steel bath, a check was done on the possible rate of dissolution of graphite in metal from the data in the literature. It is shown that graphite particles 0.4 mm in diameter blown into a steel bath at 1560°C to a depth of 250 mm are completely dissolved and pass into the melt (if the heat conductivity of carbon at high temperatures is at least as high as that of the lime particles used as the model). References 5: 4 Russian, 1 Western.

USSR

UDC 621.793.6:669.589

A NEW METHOD OF DIFFUSION ZINC-PLATING WITH HEAT TREATMENT

Moscow STAL' in Russian No 12, Dec 76 pp 1130-1131

GULYAYEV, G. I., PROSKURKIN, YE. V. and GORBUNOV, N. S., All-Union Scientific Research Institute of Pipes, Institute of Physical Chemistry, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The All-Union Scientific Research Institute of Pipes and the Institute of Physical Chemistry have developed a method of hot-zincing in a melt of zinc (with 0.1% Al added) followed by brief (10-15 min) low-temperature (530-500°C) diffusion annealing. The process gives a coating 0.1 mm thick that is distinguished by high technological and corrosion properties. The method has been introduced in a shipbuilding plant for zinc plating the tubing and pipelines of marine systems.

CSO: 1842

- END -